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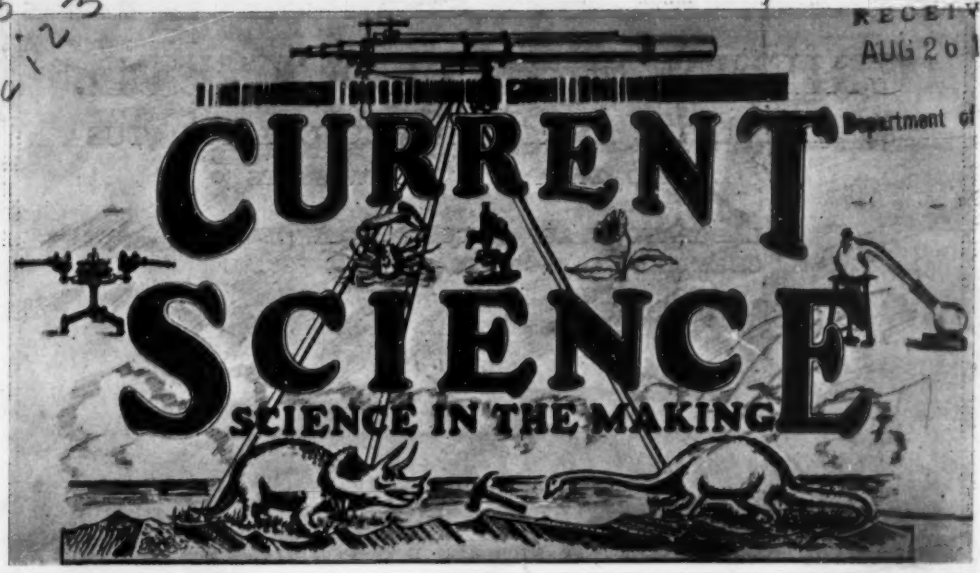
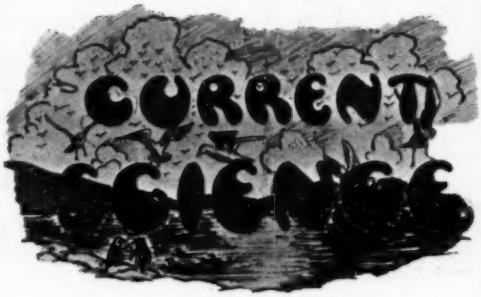



Vol. II] JULY 1933 [No. 1

A MONTHLY JOURNAL DEVOTED TO SCIENCE.

*Published with the editorial co-operation of*

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CONTENTS.





## A Society for the Protection of Game in South India.

WE extend our enthusiastic support to the proposals for the establishment of an association for the preservation of wild life in South India. It seems to us that the adoption of measures for the protection of fish is equally imperative. With the exception of the United Provinces the other parts of India do not have a central organisation commanding sufficient prestige to impose restraints on the indiscriminate slaughter of wild animals, some of which have been brought to the verge of extinction. As an instance of the grievous loss which science has sustained through the uninstructed zeal of sportsmen, we may mention the case of the Dutch settlers in Mauritius, who taking unchivalrous advantage of the half-fledged wings and short legs of Dodo (*Didus ineptus*), succeeded within a comparatively short time in clearing the island of this extremely interesting and rare pigeon. In the interests of science and wider humanity, enlightened governments have recognised the need of imposing restrictions, by the promulgation of game laws and other protective regulations, on the excesses of sportsmen and native shikaris. Wherever there is abundance of sylvan fauna, the temptation for the free use of fire arms becomes irresistible and epidemic and in the excitement, it is not uncommon for men to forget all the commandments both divine and human. The unassisted efforts of government are not adequate to meet the exigencies of the case, and they have to be supported by private associations whose influential position in public life ought to invest them with authority for exerting control on the destructive proclivities of sportsmen and ignorant native shikaris.

From Helen of Troy down to butterflies, the wearer of beauty has always been subjected to persecution and for the gratification of human vanity or pleasurable excitement or under pretexts of protection of human life and crops, large numbers of animals are annually killed, which in minds not sportively inclined evoke feelings of kindness, sympathy and admiration. Attributes such as strength, courage and dignified independence which embellish man's character confer no immunity upon lower animals possessing them. Departure from the doctrine of *Ahimsa* and the impact of

historical influences have diminished in India reverence for animal life and in the next phase of human progress it is hoped that our concept of the sanctity of life, occurring in the Amoeba or the Archbishop of Canterbury will receive a new orientation. But the urgent need is a complete revision of the ethics of sport as pursued at present. We cannot discover heroism, much less righteousness and fairplay, in enticing animals by playing cruelly on the most fundamental and universal appetite, paralysing them with the dazzling brilliance of torchlight and shattering their shoulder blades by firing with magazine rifles from an elevated place of concealment. Compared with this the mode of hunting the offending lion practised by the African tribes has all the good qualities of sport giving, as it does, the hunted beast all reasonable chances to escape and making the hunters oppose skill, strength and daring to the fury of the animal in a battle royal. In a sport it is unmanly to evade the risk and secure the spoils in a manner other than by courage. We have to humanise sport. We should not countenance slaughter without provocation.

The principal offence for which the wild animals are hunted down is that they become dangerous to man and the cattle in his service and to the crops that he raises. Some of them destroy valuable forest produce and a few are reported to increase in population periodically endangering the safety of villages. A few more have the misfortune to possess bright plumage, soft fur, bright skins and succulent meat. Frequently, however, not for any of these provoking causes, wild animals incur the fatal displeasure of man because they provide him with recreation and excitement. To a large extent man is directly responsible for the homicidal tendencies of the more ferocious animals and for the depredations of others on cultivated lands. The former have to be outlawed. But the produce of the land is amply protected from elephants and boars, when the area is surrounded by a deep moat. The population of animals is under the operation of the inexorable physical laws of nature which maintains a balance of power among them, and reports of overpopulation are based on casual observations of herds which driven from their natural haunts by drought or flies, appear in the vicinity of villages. Human pleasure need not necessarily depend on the painful death of lower animals but may be derived from contests offering opportunities for displaying skill, strength and endurance. Occasions might arise when the wild animals, after becoming a source of danger to man and all his belongings, refuse to be dislodged from the positions they have taken up and in such cases they have to be captured alive and added to the zoo. It seems to us that forests are to be treated as fertile recruiting grounds for periodic enrichment of the zoos, parks, museums and other public places of amusement and instruction, instead of being used as a field of infernal carnage.

The Association, when it is formed, will be confronted with a very difficult and delicate task, and without anticipating its functions, we may point out that if it is to serve the high purpose for which it is founded, its activities ought to be continuous and wide-spread. Through a great deal of propaganda work, the Association will have to acquaint the people in general and the shikari section in particular that the interests of science and the cause of deeper humanity forbid the indiscriminate slaughter of animals however ferocious, and irrespective of the amusement their death may provide. The game laws and protective regulations have to be popularised and the Association should publish periodically complete and correct accounts of the life habits and the distribution of the larger denizens of the forest and the economic uses of conserving animal life. A beginning is to be made in the rural schools where infants ought to be encouraged to tend pet animals and grown-up children should be taken out on excursions for observational studies. The habits of animals in our immediate surroundings exercise a great fascination on our mind and the sympathies early contracted restrain the development of destructive tendencies. Children in the urban areas ought to be taken out periodically to the zoos which, if stocked with a representative and rich collection of animals, must provide, under competent guidance, many a useful and intelligent lesson on animal colour, classification, bionomics, ecology and geographical distribution. Frequent visits consolidate the early sympathies formed in the elementary schools and tend to keep the heart warm for the animals. More important perhaps than all this is the education of the villagers. They should be made to realise that the safety of their cattle depends on their keeping them in a perfect phalanx on

the grazing ground and that the cattle and goats entering the reserve sections of the forests attract the tigers and panthers which, emboldened with the success of their adventure, will realise that it is easier to strike down the domestic animals than chase the deer. In trying to rescue his cattle from the clutches of their enemies, the villager succeeds in injuring them and the result of all this is to convert a forest dweller into a prowling village thief. Elephants, pigs, bisons, deer and antelopes can be successfully kept out of the cultivated grounds by a trench which, besides serving as a barrier, will help to conserve the moisture in the subsoil that is so essential for the prosperity and fertility of the lands. This is an expensive and laborious task and the slack season in agriculture will provide the necessary time, and labour may be secured on a co-operative basis. Even if it were desirable, it would be impracticable to suggest that wild animals should not be killed for their flesh, but energetic measures will have to be taken by the Association that all such activities are limited to a single definite purpose and that in no case the permission granted is abused. The administration of game laws is always fraught with difficulty and in some cases even with danger. The active co-operation of the planters and native shikaris will have to be enlisted by the Association in the enforcement of the government regulations and the powers of forest officers should be enlarged to deal with cases of violation of the rules.

It must not be forgotten that the present age delights in sensational thrills and excesses, and measures the merit of things by their advertisement. People have a more touching faith in the "sanctity of broken records" than in the enduring value of work done in solitude and tranquillity. Hunting either for obtaining pleasure or for establishing new records must be deprecated. It will have to be resorted to only for the removal of evil. The aim of the Association should be to encourage the study of the habits of wild animals in their native haunts, their interdependence in the economy of nature, their adaptive modifications, their evolutionary history, their jealousies, affections and antipathies, their social instincts and crude forms of patriarchal government among gregarious forms and all those features of unsophisticated wild life which instruct the human mind and ennoble its sympathies.

The Association will have to treat this task as a humanitarian mission, the reward for its successful and satisfactory accomplishment is the gratification that its members have restrained the reckless waste of animal life whose closer and sympathetic study might furnish clues to an illuminating interpretation of some of the obscure and puzzling psychological and sociological problems of man. In the supreme interest of science, elephants and the South Indian ibex which possess a historical importance should receive special consideration and the Association should regard their protection as its sacred duty. We fully realise the magnitude and the importance of the task which will be assigned to the Association and we hope that its formation will not be unduly delayed. The generous support and enthusiasm which H. E. the Governor of Madras has accorded to the movement and the co-operation which the Association expects from the enlightened Governments of South Indian States offer hopes of success.

## Acknowledgment.

WE acknowledge with deep gratitude the generous grant for *Current Science*, of Rupees Three Hundred per annum for three years, by the Government of His Highness the Maharaja of Mysore. That His Highness' Government should have made this grant in the present state of financial stringency is an additional proof of the great sympathy with which they encourage the cause of Science. We are optimistic. We believe that in the near future, other Provincial Governments and Indian States will appreciate our services in an equally handsome manner.

## A Review of the Work on Fungi in India.

By Dr. H. Chaudhuri,
*Punjab University.*

THE number of annual contributions on fungi and plant pathology in recent years has reached such enormous proportion that it is almost impossible for any one person to keep in touch with the various problems connected with this group of plants. Necessarily any attempt to put together the subject-matter of contributions in the course of a few pages, even of the Indian contributors must be a very sketchy one and arbitrary selection of papers has to be made. Investigation on fungi has been carried on in India, till recently by the Departments of Agriculture and Forestry. The work from the latter department has been confined amongst the workers connected with the Forest Research Institute at Dehra Dun, for no Provincial Government in India could claim to possess any properly equipped laboratory for its forest department. But it is not so with the agricultural departments. Besides the Mycological section in the Imperial Agricultural Research Institute at Pusa, the Provincial Governments of Punjab, Bombay, Madras, C. P. and U. P. as well as many of the Indian States possess well-equipped laboratories for plant pathological studies. Research officers of these agricultural departments have to devote their time mostly in the investigation of the diseases of economic plants just as forest officers have primarily to concentrate their work on problems connected with the protection of forest trees. Hence till very recently, investigations on fungi were confined to problems connected with plant diseases only. The field of research work on fungi has, however, been considerably broadened during recent years by the establishment of research departments in some of the Universities and Colleges. Punjab and Allahabad Universities and also the University of Calcutta have well-equipped laboratories and the Carmichael Medical College, Calcutta, Agra College, Agra, and Gujerat College, Ahmedabad, have laboratories for specialised work in fungi. From these University and College laboratories valuable contributions on various aspects of fungi are being made. Besides these centres of research, the work of the Mycological section of the Indian Tea Association deserves special mention. The work of these various research stations will now be briefly stated.

*Forest Department.*—Earliest papers mostly consist of occasional notes on fungi collected by the forest officers. Thus Cooke (1876–79) described some fungi collected by Gamble. Barclay (1889–92) described some rusts and Nisbet (1895) wrote on cankers and rots, and Gamble (1899) published a note on some Indian fungi. Later Troup, Fernandez, Brandis, Coventry and others published a number of notes on fungi. The credit of a first systematic study of Forest Fungi goes to Butler (1905). Troup investigated *Peridermium cedri* as a destructive pest of Deodars. Hole drew attention to the importance of ecological studies in control of diseases and suggested new fields of research. Spike disease of sandal, which is now classed as a virus disease and work on which is now being jointly carried out by the Indian Institute of Science, Bangalore, and the Mysore State officers, was first reported by Barber (1903). The same year Bensen and later Rao, Lushington, Hole, Jackson, Coleman, Latham, and others have contributed on various aspects of the disease and put forward various theories. Wood-rotting fungi have received special attention. Butler (1903) and later Cooper, Haines, Glover Troop, Trevor and others have worked on it. Hole published his results of his field observations of *Trametes pini* on several hosts. Systematic studies of forest fungi and also inoculation experiments are now being made. Bagchee made careful investigation on the infestations of *Peridermium complanatum* on the needles and *P. himalayens Bagchee*, on the stem of *Pinus longifolia*. A new species of cronartium from the Himalayas has also been recorded by Bagchee. Hafiz Khan investigated coloeosporium and cronartium rusts of forest trees. He also investigated a few root-rot of trees.

The largest number of papers have no doubt been published from the Agricultural Departments of the Government and of the States. The research in mycology and plant pathology in India began with the appointment of Butler as the Imperial Mycologist at Pusa (1905) and it may be safely said that before Butler there has been no research in

Mycology in India. Butler's book *Fungi and Plant Diseases* gives an account of the work done at Pusa on sugarcane, cereals, pulses, fibres, vegetable crops, etc. This book records all the work upto 1918. In addition, work has been done by Butler in collaboration with specialists in Europe, such as Sydow. The major portion of the work done on Indian fungi has been recorded by Butler and Bisby in the *Fungi of India* published by Imperial Council of Agricultural Research as Monograph No. 1 of 1931. This records most of the publications up to 1929. It has got a bibliography and a list of synonyms. Besides numerous papers on plant diseases published by him, Butler has also published an account of the genus *Pythium* and some *Chytridiaceæ*.

Intensive work has been done on the wilt of rahar (*Cajanus indicus*) due to *Fusarium vasinfectum*, by McRae and Shaw. It has been controlled by resistant varieties. Shaw studied diseases of the jute plant and also the morphology and parasitism of Rhizoctonia. Cereal diseases due to Helminthosporium have been described by Mitra and four new species recorded for India. Mitra has recorded a new bunt of wheat—*Tilletia indica*, Mitra. It is interesting, as throughout the world only two species *Tilletia tritici* and *T. Levis* have been recorded. Gram blight due to *Phyllosticta rabiei* (Pass) in the Punjab, has been studied by Luthra. He also investigated red leaf spot of Jowar due to *Colletotricum graminicolum* and found the disease to be seed-borne.

Ajrekar in Bombay studied the mode of infection and prevention of the smut disease of sugarcane and a disease of jowar caused by the conidial stage of Cleviceps. Ajrekar, Bal and Kamat studied the cotton wilt problem. Kulkarni and Mundkar studied the wilt disease of cotton in Dharwar. Various smuts of jowar, ragi and on Sawn have been studied by Kulkarni. Uppal and Kamat brought about artificial infection of Bajra by *Sclerospora graminicola*. The *Sclerosporas* on various hosts in Bombay Presidency have been studied by Uppal, Desai and Kulkarni. Weston and Uppal redescribed as a new species *Sclerospora sorghi* (Kulk.). Uppal found *Sclerospora graminicola* to split into specialised races and that one physiologic form attacked bajri and the other *Setaria* sp., and *Euchlæna muxicana*. Cheema and Bhat studied the dieback of citrus trees and found very good results by manuring and trenching. In the control of Cumin Powdery Mildew, Uppal and Desai found that an application of sulphur (25 lbs. per acre) made at about the time of flowering gave complete control of mildews.

In Madras Presidency McRae studied the life history of *Phytophthora Meadi* n. sp., on *Hevea brasilenses* which reduces the yield of latex by causing heavy leaf fall. Sundararaman described a new ginger disease from Godavari District due to *Vermicularia zingibræ*. He found spraying with Bordeaux checked the disease. Cocoanut stem-bleeding disease due to *Thielaviopsis paradoxa* which ultimately kills the trees has been studied by Sundararaman, who has suggested control by scooping out all the diseased tissues and applying hot tar. This organism also causes the stem-bleeding of areca-nut and treatment is similar. Sundararaman and Ramakrishnan described the Mahali disease of cocoanut due to *Phytophthora arecæ*. Spraying the nuts with Bordeaux before monsoon bursts has been found to control the disease. Sundararaman also studied some Vermicularias of economic importance in the south and the life-histories of *Phytophthora Pini var. Antirrhini* causing foot-rot and wilt of *Antirrhinum*, a smut *Setaria italica, viz., Ustilago crameri* and *Helminthosporium oryzæ*—a paddy disease. Sugarcane mosaic has also been studied and inoculation experiments showed that infection is caused through setts and by insects.

Dastur studied the foot-rot disease of pan in the Central Provinces. The striga disease of jowar and sugarcane has been studied by him. He found treating the infected cane clumps, with copper sulphate, controlled the disease successfully. In the *Anthacnose* disease of the bolls of cotton due to *Vermicularia* sp., Dastur found that addition of sulphur or sodium sulphate to wilt-infected soil had a controlling influence on the incidence of the disease. A new disease of the castor oil plant due to *Phytophthora parasitica* nov. sp., has been described by Dastur. The oogonium of this species in passing through the antheridium, gets fertilized, the latter remaining as a collar at the base of the oogonium. Jiwan Singh studied the *Fusaria* from cotton plants and soils in C.P. and from inoculation experiments, he found that they were incapable of infecting plants though they remained viable in the soil. Regarding gram wilt, Dastur doubts if it is due to any pathogenic organism. The mode of infection of smut by sugarcane has also been studied by Dastur.

From U.P., Dey studied the physiology of the appressorium of *Colletotrichum glœosporioides*, isolated from *Citrus medica* var. acida. He found that stimulated by the substances diffusing out through the cuticle, the appressorium sends out a fine infectious hypha from its adpressed surface which finally ruptures the cuticle mechanically, in a way similar to that found by him in *C. lindemuthianum*.

Besides the Government Agricultural Department, best work from the Indian State Agricultural Departments is, no doubt, from the Mysore State. Coleman has extensively worked on the rot of the Areca Palm and later Narasimhan worked on the same thing. Narasimhan made a study of the genus *Phytophthora* from Mysore. He isolated heterothallic strains of *Phytophthora*. Similar strains of *Phytophthora* from Areca and Aleurites have also been isolated and described by Venkatarayan. Narasimhan has done cytological investigation of the sandal spike-disease and found intercellular bodies associated with the disease similar to those described in other virus diseases. Sreenivasaya from the Institute of Science, Bangalore, worked on the disease transmission in sandal spike.

In Baroda State, Likhite has been working on tomato viruses and other diseases.

In the Punjab University, Chaudhuri and Rajaram made some interesting observations regarding *mycorrhiza* in *Marchantia nepalensis*. The endophyte was isolated and by means of inoculation experiments, a reciprocal symbiosis has been shown to exist. The green plant supplies the fungus with carbohydrates and the specific endophyte is necessary for the formation and maturation of the sporophyte generation. Chaudhuri described a *Myzocitium* growing on *Spirogyra affinis* covering the characteristics of at least three known species of *Myzocitium*. Sawhney worked out a *Capnodium* disease of cotton. Nazir Ahmad studied the dung-fungi of six animals and a large number of new species has been recorded. A large number of soil fungi has also been studied by Singh. Chaudhuri studied the green-ear of Bojra and made successful artificial inoculation and also studied the germination of the oospores. The Casuarina root-nodule organisms have been studied by Chaudhuri and irregular occurrence of the nodules discussed. He also studied a partial wilting of *Hibiscus tiliacens* caused by the staling product of *Alternaria*. Chaudhuri and Gopal Singh studied the wither-tip disease (*Colletotrichum glœosporioides*) of the citrus plants and the effect of the environmental condition on the virulence of the organisms has been shown. Saltation in fungi has been experimentally studied by Chaudhuri and has been found to be a nutritive phenomenon, unless it be a true case of mutation. Chaudhuri and his students studied various diseases of the tea bush, orchards and vegetable crops and also the effect of X-rays and ultraviolet rays on the physiology of certain fungi.

From Allahabad Mitter (J. H.) and his pupils have been working on the fungus flora of that place and also of Naini Tal. Mitter and Tandon have published notes on two fungi isolated from an Indian hill apple and also *Sclerospora graminicola* on Bajra. Mitter in collaboration with Sydow published a paper on Indian Fungi and described a new genus *Mitteriella*. Saksena made interesting observations regarding the cytology of *Pythium de Baryanum*. A study of the comparative values of various fresh fruit juice media on the growth of Fungi Imperfecti has been made by Mitra (A. K.)

At Agra, Mehta has done very interesting work regarding the dissemination of rust spores and incidence of rust epidemic. By means of slides in æroscopes, he has been able to follow the progress of the rust spores and has brought forward evidence of over-summering of rusts in several hill stations and also of over-wintering of brown and black rusts at comparatively low altitudes.

In the Carmichael Medical College, Calcutta, Bose has studied the various aspects of Bengal *Polyporaceæ* and also *Agaricaceæ*. He described a number of new forms. Bose studied the fungi cultivated by the termites of Barkuda. He contributed a paper on Golgi bodies of higher fungi wherein he showed the homology of the vacuolar bodies in the basidia of higher fungi with the golgi bodies in animal cells. Working with monosporous cultures of *Polyporusosteri formis* and *Polystictus hirsutus*, Bose found that both the species are strictly heterothallic and bisexual, in which spores from a single fruit body fall into two groups and only two. These two sexes seemed absolutely stable as they could not be changed by variations of external conditions nor by different kinds of media. From Toklai in Assam, the experimental station of the Indian Tea Association, a large number of important papers have been published by Mann, Tunstall and Tunstall

and Bose. The station is maintained for exclusive study of tea diseases. A very large number of papers have been published by Tunstall on various stem, root and leaf diseases of the tea. He also studied the micro-organisms associated with tea fermentation.

The author is afraid that the above review has been a very sketchy one and works of many of the authors could not be mentioned. Before concluding, he expresses his thanks to many of the authors who helped him with their publications and reports of the work of their departments.

## The Occurrence of Mundwinkeldruse in the South Indian Frogs.

By L. S. Ramaswami, B.Sc.,

*Department of Zoology, Central College, Bangalore.*

UNDER the title "Mundwinkeldrüse" De Villiers has described a gland of problematical function, occurring in the upper jaw of some of the South African anura such as *Anhydrophryne*,[5] *Probreviceps*,[9] and some Ranids. However, in *Breviceps fuscus*[6] which is closely related to *Probreviceps*, he has reported the absence of this interesting gland. This structure is in no way peculiar to the amphibious anura since Fuchs[7] has noticed its presence and discussed its importance among the reptiles.

In *Anhydrophryne*[5] which according to Villiers is almost a Ranid, he has given the following description of the gland: "This glandular structure is located in a groove of the maxillary, its wall is two layered, the inner layer being richer in nuclei than the outer. Histologically the structure resembles adenoid tissue, but it possesses a lumen which opens into the mouth cavity. The organ has a rich blood supply; its innervation was not determined."

The present paper which is the first of the series, embodies the results of an investigation undertaken to determine the topographical relations and the histological character of the maxillary gland situated in the maxillary of some of the South Indian batrachians. Sections of the head of several genera of Ranid and Engystomatid families were made. It is peculiar that there is a great divergence as regards the general shape, occurrence, size and relations with the associated structures of this gland.

There is abundance of evidence in support of the view that the Engystomatidæ constitute a primitive family showing specialisations in certain characteristics produced as adaptive modifications by the extraordinarily peculiar habits of life assumed by them. And even within the limits of a single family there is a great deal of divergence in regard to the general disposition of the gland, but in all the genera examined by me the uniform occurrence of the gland is a noteworthy feature. On the other hand, among the Ranids the study of the slides points to the occurrence of this gland only in *Rhacophorus maculatus* while *Nyctibatrachus* and *Ixalus* are devoid of this gland.

I am indebted to Dr. A. Subba Rao for the *Glyphoglossus* material. I have studied the cranial osteology and conus arteriosus of this form and the results of my investigations will be published soon.

It occurs to me that a close study of the histological details and the relations of this gland in the Engystomatidæ would lead to the splitting of the family into two groups, a procedure which is supported by the investigations of conus arteriosus[3] and the brain[4] and also their cranial osteology.[8] Undoubtedly *Glyphoglossus* represents the primitive member of the group for which I possess evidence and *Kaloula* and *Microhyla* represent a separate group possibly of the same rank as *Glyphoglossus* or slightly higher in the scale of differentiation. *Cacopus* certainly represents a most highly evolved genus.

I shall now proceed to give a short description of the gland in each of the different genera at first and then proceed to discuss the probable line of its evolution. At the outset it should be remarked that the gland in *Glyphoglossus* is most simple and it assumes the greatest complexity in *Rhacophorus*. The other genera *Cacopus*, *Kaloula* and *Microhyla* occupy the intermediate stage and of these, the latter genera *Kaloula* and *Microhyla* are almost identical while *Cacopus* represents a condition which in several respects departs widely from them.

In *Glyphoglossus* the gland, situated below the antorbital cartilage, is a loose mass of adenoid tissue supported by connective

tissue matrix. In general outline the mass is oval (Fig. 1). In the glandular region the antorbital cartilage is invested by the pterygoid and maxillary bones. The gland is richly vascular. Perhaps the most interesting fact connected with the gland in *Glyphoglossus* is that the buccal epithelium enters into the adenoid in the form of two invaginations so that in sections the gland seems to possess two ducts opening into the oral cavity. But the fact is the gland possesses no duct of its own, and the gland itself may be described as an oval cap surmounting, and closely adherent to, the two tubular recesses of the oral cavity.


**Fig. 1.**

The glandular patch below the antorbital cartilage in *Glyphoglossus*.

*G*.—Gland.
*D*.—Ducts.
*A*.—Antorbital cartilage.

It is only appropriate that *Microhyla* and *Kaloula* should be treated together. In both these genera the anterior border of the gland touches the median vertical axis of the eye, and therefore is more posteriorly situated in regard to the antorbital process (Figs. 2 and 3). The hinder border does not reach however the tympanic area in both. The duct opens below the eye into the oral cavity, in other words, well in front of the angle of the mouth. In *Microhyla* histologically we can distinguish an outer cortical and an inner medullary portion, and both regions are richly vascular, and innervated by the maxillary branch of the fifth cranial nerve. The duct part is produced by a single extension of the ciliated buccal epithelium, which is numerously surrounded by mucous glands. (Fig. 4). The glandular tissue of the 'mundwinkeldrüse' does not extend into the region of the duct invested by the mucous glands. In both *Microhyla* and *Kaloula* the glandular cells bear cilia. There is, however, a small difference in the shape of the gland in the two forms. In *Microhyla* it is longer than broad and the reverse is the case in *Kaloula*. In the two forms the duct is composed of columnar epithelium with the nuclei situated terminally. The duct portion receives the secretion of the mucous glands poured through narrow channels. It is curious that at the apex of the gland two or three lymph sacs are present, and some of them are situated in such close proximity as to suggest a physiological relationship between the lymph sacs and the glands. There can be little doubt that the secretion of the gland is voided into the mouth through the ciliary action of the glands.


**Fig. 2.**

The gland in *Microhyla*.

*C*.—Cortex.
*M*.—Medulla.
*D*.—Duct.

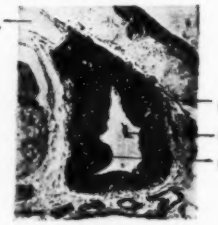



**Fig. 3.**

The gland in *Kaloula*.

*G*.—Gland.
*L*.—Lymph sac.
*C*.—Cilia.
*Cd*.—Cellular detritus.

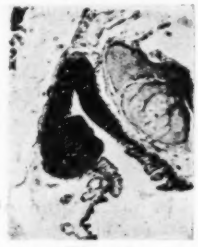


**Fig. 4.**

The duct and gland of *Kaloula*.

In *Cacopus* (Fig. 5) the anterior border of the gland begins in a line with the anterior margin of the eye but its duct opens into the buccal cavity behind the angle of the jaws. Both as regards its anterior and posterior relationships *Cacopus* differs from *Kaloula* and *Microhyla*. The gland lies freely nearer to the pterygoid and above the maxilla. The gland itself is traversed by a system of lacunæ with well demarcated internal lining and is far more vascular than in the other two preceding genera. Usually the lacunæ contain cellular detritus and stray blood corpuscles, and it is noticed that they open into the lumen of the gland. The duct which is a buccal extension is surrounded by a large number of buccal


**Fig. 5.**

The gland in *Cacopus*.

*D*.—Duct.

glands. Neither the glandular cells nor those of the buccal epithelium of the duct are provided with cilia. In this respect *Cacopus* resembles *Glyphoglossus* and *Rhacophorus*.

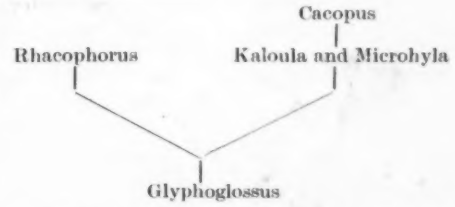
In *Rhacophorus* the gland situated above the maxillary bone has assumed large proportions (Fig. 6). It does not extend beyond the eye in front while posteriorly it touches the tympanic area, though its duct opens well in front of the angle of the jaws. In sections it is noticed that the gland has a large lumen with radiating branches, so that a star-shaped figure is noticed in some of the sections. The vascularization and innervation of the gland are identical with those of Engystomatidæ.


**Fig. 6.**
The gland in *Rhacophorus*.
*G.*—Gland.
*Ma.*—Maxilla.

A suggestion as to the probable line of evolution may be made at this stage. Assuming that the gland has a physiological significance it is noticed that it occurs in its simplest form in *Glyphoglossus* where it is a collection of highly nucleated vascular lymphatic tissue, opening into the buccal cavity by two ducts. It is distinctly antorbital in position, and probably this is the original position of the gland. In the other genera of the Engystomatidæ a backward movement of the gland has manifestly taken place. It has moved far behind in *Kaloula* and *Microhyla* than in *Cacopus*, only in respect of the anterior margin of the gland. The point to which evolutionary modification has taken place is not to be tested by the relation of the anterior border of the gland to the eye but by the position of its opening into the buccal cavity. *Kaloula* and *Microhyla* occupy an intermediate position between *Glyphoglossus* on the one hand and *Cacopus* on the other, which represent the two extreme points in the evolutionary scale. Further, while the gland retains its maxillary relation in *Kaloula* and *Microhyla* as in the case of *Glyphoglossus* it has shifted its position more towards the pterygoid in *Cacopus*.

The presence of ciliated cells in the gland of *Kaloula* and *Microhyla* should be regarded as a secondary feature and cannot have any relation with the origin of the structure which is mesenchymatous uniformly in Engystomatidæ and in other families.

Two available evidences furnished by the larva are in support of this view. In the early tadpole condition, I have studied the patches of loose mesenchymatous cells with darkly staining nuclei surrounded by fine capillaries in the antorbital region of *Cacopus* and *Microhyla*. In these tadpoles usually two glandular patches on each side of the dorsolateral aspect of the gill-arches, which in the sections appear slightly protruding in front of the eyes, can be made out. These patches do not establish at this stage buccal openings but they appear at about the time of metamorphosis when buccal recesses are being formed. When terrestrial habits are completely assumed, the glands acquire adult features. I have not been able to follow the development of the glands in the case of *Rhacophorus*, but from a study of the histological elements and topographical relations of the gland in the adults, I conceive that the line of evolution should have proceeded as in the following sketch which is not to be supposed to have any phyletic significance.




In this connection I may state that the sections of the head of examples of Apoda such as *Uræotyphlus* and *Ichthyophis* which have been studied do not show the presence of such glands. No reference is available as regards the occurrence or otherwise of the maxillary gland in Urodela, and it is difficult to decide whether the glands have any appreciable physiological function among the Anura in which their presence is reported.

I am appending below a tabular statement showing the topographical relations and dimensions of the gland in the forms discussed in this paper :—

| Examples | Location | Extension | Size in $\mu$ |
|---|---|---|---|
| Glyphoglossus | As a patch below the antorbital cartilage invested by the pterygoid. | Commences before the eye and ends before the anterior limit of the eye. | 230 |
| Microhyla | Between the pterygoid and the maxillary. | Commences at a level with the median vertical axis of the eye and extends posteriorly to it. The duct opens well in front of the angle of the mouth. | 270 |
| Kaloula | do. | do. | 500 |
| Cacopus | Between the pterygoid and the maxillary with the mandible below. | Commences at the anterior extremity of the eye and opens behind the angle of the mouth. | 880 |
| Rhacophorus | do. | Commences at the anterior margin of the eye and the duct is seen in the region of the annulus tympanicus, but opens in front of the angle of the mouth. | 1060 |

*References.*

[1] Ecker, *Anatomy of the Frog*, 1889.

[2] Jolly, *J. Compt. Rend, Biol.*, **71**, 200, 1919.

[3] Narayan Rao, C. R., and Ramanna, B. S., *Proc. Zool. Soc.*, Part 4, 1445, 1925.

[4] Narayan Rao, C. R., *Journ. Mys. Uni.*, **4**, No. 1, 1930.

[5] De Villiers, C. G. S., *Anat. Anz.*, **71**, 331, 1931.

[6] *Ibid., Anat. Anz.*, **72**, 164, 1931.

[7] Fuchs, H., *Nachr. v. d. Ges. der Wis. Zu. Gott., Fachgruppe*, **6**, 131, 1931.

[8] Ramaswami, L. S., *Journ. Mys. Uni.*, **6**, No. 1, 1932.

[9] De Villiers, C. G. S., *Anat. Anz.*, **75**, 257, 1933.

## Physical Nature of the Nerve Impulse.*

By Prof. A. V. Hill, O.B.E., F.R.S.

IN his Friday evening discourse delivered at the Royal Institution on 10th February 1933, Prof. A. V. Hill has discussed the nature of the nerve impulse, a subject which has engaged the attention of physiologists and which has given rise to much speculation. According to Prof. Hill, "the nerve impulse is an event, a wave, a propagated disturbance, not a substance or a form of energy. It is transmitted along a thread of protoplasm which in medullated nerve is surrounded by protecting or 'insulating' sheath. Its passage can be detected in several ways: (*a*) by its physiological effect on the organ to which it runs, (*b*) by the electric change which accompanies its transmission, (*c*) by the production of heat, and (*d*) by a consumption of oxygen and liberation of carbondioxide." The properties of the nerve impulse are discussed giving the methods of recording the variations that are brought about during the event. Under other effects of oxygen, the lecturer describes the result of the action of certain drugs like veratrine and curare.

The strength, duration, the manner in which excitation by an electric current occurs and the nature of the propagated disturbance are discussed. The factors which determine the excitation time are noted. The difference in the behaviour of different fibres or of the same fibre under different conditions which is due to the alteration in the electrical resistance is explained by the probable specific solubility in the lipoidal substance of the nerve sheath under the influence of potassium ions.

The account of the mito-genetic radiation in nerve on which the Russian school is working is indeed very interesting, if not exciting and if confirmed will gain very great social and industrial importance.

A. SUBBA RAO.

* *Nature*, April 8, 1933.

## Letters to the Editor.

### The Multiple Testis of *Ichthyophis glutinosus*.

ACCESSORY testicular lobes have been reported from Urodela, Gymnophiona and Anura and while the origin, nature and significance of these bodies have been subjected to very critical examination in many urodeles and some anura, literature does not show any reference to the multiple nature of the testis in Gymnophiona. Nussbaum[1] who was one of the first to describe the segmented nature of the testis in several species of urodeles, correlated the degree of development of the multiple testis with the time of the year and the age of the animal. Champy[2] thought that the segmented condition of the testis was due to the elongation of the body of the animals. Kingsbury[3] found the lobed testis more common in adults than in young ones of *Desmognathus fusca*. A new explanation of this phenomenon was given by Humphrey[4] who, following Spengel[5] thought that the regular caudo-cranial development of the germ cells and their very slow ripening in many urodeles have resulted in this segmented condition of the testis. It is to be remembered that in most of these cases, especially those examined by Humphrey[4] in between the lobes of the testis an abundance of germ cells is found and no part of the testis is entirely free from them.

In marked contrast with the urodeles is the condition found in the Gymnophiona. As far back as 1876 Spengel[5] noticed the entire absence of germ cells between the segments of the testis. And unlike urodeles even in an immature animal the testis shows segmentation and I have reasons to believe that after a certain age, the number of the testis lobes does not increase in the animal.

Obreshkove[6] in a recent communication on the multiple testis of *Diemyctylus viridescens* gives a different explanation as to the origin of the multiple testis in this animal. He finds the lobed condition even in immature animals and in addition to the regular and connected system of testis segments certain isolated germ cell groups are found, sometimes not in the direct axial line of the germ cord, which have led him to conclude that the multiple condition of the testis in *Diemyctylus viridescens* has arisen from distinct rudiments unconnected with one another. Peritoneal cells are in this animal capable of giving rise to islands of germ cells. This explanation of Obreshkove, though refuted by Humphrey[7] in a later communication, offers, I believe, an approach to the correct understanding of the subject of multiple testis in Gymnophiona. Distinct germ cell proliferations appear independently along the sex cord and these at first are in the nature of solid masses of rounded cells traversed in the centre by a duct. It can be distinctly seen that the germ cells have aggregated to form nests, which, when the testis capsules are formed as outgrowths from the duct, migrate into them.


**Fig. 1.**

Longitudinal Section of a testis lobe of the larva of *Ichthyophis glutinosus* measuring 11·5 cms.

*D.*—Duct.
*G.C.N.*—Germ cell nests.

In the latest contribution to the subject of the anatomy of the testes of Gymnophiona, Tonutti[8] reports that in *Hypogeophis*, the anterior testis lobes are generally larger than the posterior ones. He thinks that some of these anterior larger lobes are formed by the fusion of two originally distinct ones. In *Ichthyophis*, however, I cannot make out any such fusion nor can I trace, with definiteness, any regular transitional difference in size between the anterior and posterior lobes. The posterior lobes in many cases are as large as and sometimes even larger than the anterior ones.

It will be recognised that the indefiniteness in the number of the testis lobes in

[1] Nussbaum, M. *Arch. fur Mikr. Anat.*, **68**, 1, 1906.
[2] Champy, C. *Archiv. de Zool. Exper. et Gen.*, **52**, 13, 1912.
[3] Kingsbury, B. F. *Amer. Journ. Anat.*, **1**, 1901.
[4] Humphrey, R. R. *Biol. Bull.*, **43**, 45, 1922.
[5] Spengel, J. W. *Arb. aus dem Zool. Zootom*, **3**, 1, 1876.
[6] Obreshkove, V. *Journ. Morph.*, **39**, No. 1, 1, 1924.
[7] Humphrey, R. R. *Journ. Morph.*, **41**, No. 2, 283, 1926.
[8] Tonutti, E. *Morph. Jahrb.*, **68**, 151, 1931.

different animals and on the two sides of the same individual will have to be explained adequately. The factor that determines or influences the development of the individual number of the testis lobes is not known, and it seems to me that individual and lop-sided variations have no specific or physiological significance.

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*June* 27, 1933.

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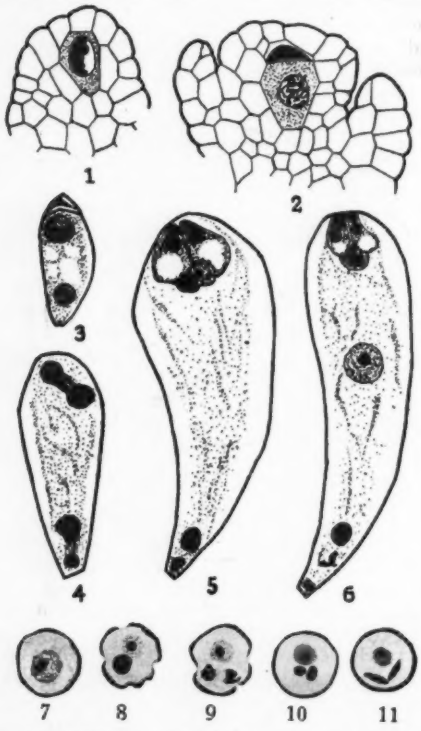
## Contribution to the Morphology of *Limnophyton obtusifolium* Mzq.

PLANTS of the family *alismaceæ* have been investigated by several workers, each obtaining somewhat different results from the other. Schaffner worked out *Alisma plantago* in 1896 and *Sagittaria latifolia* in 1897 and reported an eight-nucleate embryo sac. Dhalgren in 1928 worked out *Alisma plantago* and a few other genera




of the family and finds a six-nucleate embryo sac.

A considerable quantity of material of *Limnophyton obtusifolium* was collected from Bharatpur to obtain a close series of stages giving the development of the female gametophyte. The flowers are borne in 4-5 whorls on a long peduncle. They are of two kinds either purely male or hermaphrodite. Hermaphrodite flowers occur in larger numbers in the lower whorls and are fewer in the upper ones. There are six stamens and numerous free carpels.

*Female gametophyte:* There is a hypodermal archesporial cell (Fig. 1) which functions directly as the mother cell without cutting off a wall cell. After the first reduction division is completed; it divides into two cells of which the upper degenerates early (Fig. 2) and the lower divides twice and produces a four-nucleate embryo sac (Figs. 3 and 4). Two nuclei are at the chalazal end and two are at the micropylar end. The former do not divide further, and the micropylar nuclei divide but once producing four nuclei. The mature embryo sac is thus six-nucleate (Fig. 5). There is the usual egg-apparatus; one of the group of the four micropylar nuclei functions as the upper polar nucleus; and of the two lower, one is the lower polar nucleus and the other represents the single antipodal nucleus. This is the smallest nucleus of all the nuclei in the embryo sac and soon degenerates. The difference in the size of this nucleus as compared with the others can be seen even at the four-nucleate stage. The upper polar descends down to meet the lower polar in the middle of the embryo sac (Fig. 6).

*Male gametophyte:* A single row of hypodermal cells in each anther lobe, as is usually described for other plants, is not distinguishable. A group of sporogenous cells differentiates in each lobe and the outer cells differentiate into a tapetum, which gives rise to a true periplasmodium. The microspore mother cells undergo two successive divisions to form isobilaterally arranged tetrads. The microspore nucleus (Fig. 7) divides producing a large tube and a smaller generative nucleus (Fig. 8). The latter again divides (Fig. 9) producing two spherical male nuclei (Fig. 10), which later become spindle shaped (Fig. 11). The mature pollen grain is thus tri-nucleate.

*Embryo:* The development of the embryo follows the usual course laid down for the monocots. The basal cell is very large and conspicuous. The endosperm is of the Helobiales type.

I am indebted to Dr. P. Maheshwari who suggested the problem and under whose directions the work was carried out.

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*June* 1, 1933.

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## The Development of the Endosperm in *Asphodelus tenuifolius* Cav.

IN a recent paper written by me in collaboration with Singh[1] there appears a statement that "The endosperm nucleus divides first and a free nuclear endosperm is formed". Further study made by me shows that the latter part of the statement needs to be modified.

The primary endosperm nucleus lies at the base of the embryo sac just above the antipodal cells which begin to disappear very soon after fertilisation. When it divides a wall is formed separating a small chalazal chamber from a large upper chamber. The nucleus in the chalazal chamber divides only once or twice, while the other nucleus in the upper chamber undergoes several free nuclear divisions. The figure shows an embryo sac in which the fertilised egg is still undivided though the endosperm is separated into two chambers of which the upper has several free nuclei and the lower has only four nuclei. This type of endosperm development is known as the Helobiales type and has already been reported in another sp. of *Asphodelus* by Stenar[2], who writes:—


"Bei *Asphodelus fistulosus* ist die basale Zelle klein und kann leicht übersehen werden. In den wenigen Präparaten mit Endospermstadien, die mir zur Verfügung stehen, enthalt die untere Kammer vier Kerne. In dem ältesten beobachteten Stadium waren diese mehrfach grösser als die Kerne im zentralen Endosperm."

It is due to the small size of the chalazal chamber (as noted by Stenar also) and the lack of median sections that it was overlooked in my earlier preparations.

P. MAHESHWARI.

Botany Department,
Agra College, Agra,
*June* 12, 1933.

[1] Maheshwari, P., and U. B. Singh. "Development of the Female Gametophyte of *Asphodelus tenuifolius*." *Jour. Ind. Bot. Soc.*, **9**, 31, 1930.

[2] Stenar, Helge. "Zur Embryologi der Asphode line-Gruppe." *Svensk. Bot. Tidskr.*, **22**, 145, 1928.

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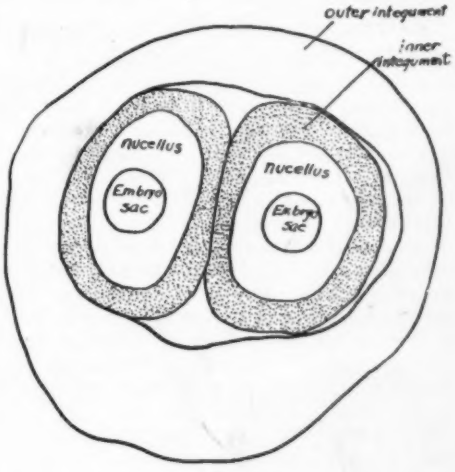
## A Note on the Life History of *Hydrilla verticillata* Presl.

THIS note presents briefly the results of a detailed study of the flower and seed development of this plant, with special reference to the deviations from the normal course of development found in angiosperms.

*Male flower:* During the development of the microspores the tapetum forms a periplasmodium. The tetrads are isobilateral. The pollen is tri-nucleate at the time of shedding, consisting of a vegetative nucleus and two lenticular male cells. There is no fibrous layer in the anther, which is evidently in adaptation with the aquatic habitat of the plant.




*Female flower:* The ovules appear as protuberances from the inner surface of the ovarian cavity and the archesporial cells are usually distinguishable at a surprisingly early stage. There are 1-3 sporogenous cells in each nucellus, but only one goes through

the reduction divisions, producing a linear or T-shaped tetrad of four megaspores of which the lowest functions. Its nucleus divides to give rise to the eight nuclei of the embryo sac which is of the usual organisation. The antipodal cells are ephemeral.

Paired ovules, borne on a single funiculus, were met with occasionally. The two nucelli had each an inner integument of their own, but a common outer integument. This is shown clearly in the figure which is drawn from a section passing transversely through the nucelli. Both the gametophytes were developing simultaneously and there is, thus, a possibilty of the occurrence of "false polyembryony".

*Endosperm and embryo:* The endosperm formation is of the Helobiales type. The lower cell enlarges considerably and remains undivided so that it can be seen even up to the formation of the cotyledon. The embryo is of the usual monocotyledonous type with a large basal cell. The full paper will soon be published elsewhere.

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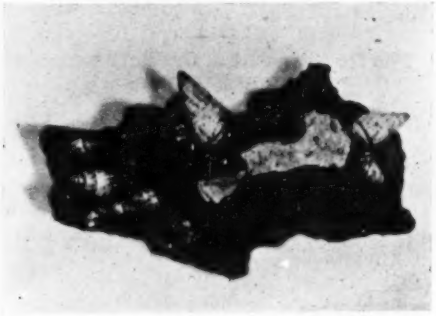
*June* 12, 1933.

## An Aestivating Gastropod from Mysore.

THOUGH it is a well-known fact that several gastropods protect themselves readily from the seasonal droughts, very little of it was known in the Indian forms until 1925 when Hora[1] reported on the æstivating habit of *Succinea arboricola* (Rao) from the Western Ghats. Later Hora and H. S. Rao[2,3] have extended our knowledge of this phenomenon to several other Indian gastropods.

When in last April, I had been out collecting fishes from Bethmangala tank, six miles from Kolar Gold Fields, I observed a few small gastropods æstivating in the crevices of the trunk and branches of Pongamia. They were tenaciously sticking to the bark of the trees. Most of them were young ones. I collected a few of them with the bark and sent some to Dr. Hora of Calcutta, for identification. The mollusc has been identified as *Rachisellus punctatus* (Anton) and so far as I can find from the literature available on the subject, its æstivating and tree climbing habits have not been recorded. A few of them were revived to activity in the laboratory by bringing them in contact with a small quantity of water. The epiphragm is thin and membranous and covers the shell completely. It



A piece of wood showing a number of æstivating *Rachisellus punctatus*. (*Natural size.*)

becomes soft in contact with water. The animal moves actively on moist surface, but on recurrence of dry condition it withdraws itself into the shell and secretes another epiphragm within about fifteen minutes. When they are detached from the bark they generally fail to secrete the epiphragm and finally desiccate in a few hours. But in very few cases, however, a thin epiphragm is secreted inside the shell, which protects the animal from drought.

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## Aerial Respiration in *Pseudapocryptes lanceolatus* (Bl. & Schn.)

WITH reference to Dr. B. K. Das's account of a 'hitherto unknown' mode of ærial respiration in *Pseudapocryptes lanceolatus* (*Cur. Sci.*, **1**, 389, 1933), the following passage from Day [*Journ. Linn. Soc.* (Zool.) XIII, p. 202, 1877] is of special significance:

"In 1871, at Calcutta, I procured some living specimens of eels (*Ophichthys boro*). The gills of this fish are contained in large cavities, one on either side of the head, those on one side being divided from those of the other by an impervious septum. On watching its movements, it was seen to distend this receptacle with air taken in at the mouth, or, if in water, to live equally well by passing this fluid through the gill-cavity. On holding its small gill-opening firmly closed, it took in air by its mouth in distinct gasps: if its mouth were (*sic*) closed, it struggled until it was released, as, of course, without its use it could

[1] Hora, S. L. *Rec. Ind. Mus.*, **27**, 1925.
[2] Hora, S. L. and Rao, H. S. *Rec. Ind. Mus.*, **99**, 1927.
[3] Hora, S. L. *Rec. Ind. Mus.*, **30**, 1928.

not respire. On exposing the gills by cutting away the gill-membranes, and then placing it in water, it could be seen to slowly move its branchiæ, even when in such a situation that it could not obtain atmospheric air direct. It appeared to be able to employ for respiration air dissolved in water or air inspired directly from the atmosphere."

Attention may here be directed to a recent paper by Elfriede Schöttle entitled "Morphologie und Physiologie der Atmung bei wasser-, schlamm-und landlebenden Gobiiformes" (*Zeitschrift Wissen. Zoologie*, **143**, 1, 1932). A detailed account of the bionomics of almost all the well-known estuarine Gobioid fishes of India is contained in this article. *Pseudapocryptes lanceolatus* is also dealt with.

SUNDER LAL HORA.

Zoological Survey of India,
Indian Museum, Calcutta,
*June* 24, 1933.

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## Light Source in Hyperfine Structure Work.

IN experimental investigations on hyperfine structure it often becomes necessary to use a source which has the effect of showing the weak satellites relatively enhanced. For instance, in the case of Zn which has the following isotopes 64, 66, 68, 67 and 70, the order being that of decreasing relative abundance, the satellites corresponding to isotope 67 whose abundance is of the order of 5% (certainly not more than 10%) would be relatively faint. With the object of enhancing these satellites the source described in *Current Science*, Vol. I, p. 264, was devised. Essentially it consists in passing a stream of Zn vapour through a cooled-cathode mercury arc of length 30 cm. with a tungsten anode, observation being made axially. With such a source selective absorption has the effect of enhancing the weak satellites. Hence the intensities of the satellites corresponding to isotope 67 in the hyperfine structure patterns of the Zn I lines $4\,^3P_{0,1,2}$–$5\,^3S_1$, cannot be even in approximate agreement with the relative abundance of this isotope. The enhancement of weak satellites is of great utility when the objective is only the measurement of wavelength separations. It is hardly necessary to say that the second stage of self-reversal when a line becomes double should not be reached. In the case of the apparatus under consideration it is easy not to reach this stage by so regulating the stream of Zn vapour that the main component in each case never shows a doubling. It may be mentioned that in such an apparatus a satellite corresponding to an isotope whose relative abundance is small may approach or even outstrip in intensity a satellite of an isotope present in much larger relative abundance.*

When the reasoning centres round the relative intensities of the hyperfine structure components, self-absorption must be avoided. Especially is this so when, as in the case of Cs, resonance lines are under examination. One way of minimising self-reversal was described by Venkatesachar and Sibaiya in *Current Science*, Vol. I, p. 303. The method consisted in introducing a small quantity of caesium chloride into a vertical mercury arc with a tungsten anode. When the metal Cs was introduced into the arc, the two components of the resonance line were nearly equal in intensity, whereas when Cs was replaced by CsCl the components grew sharper and the intensity difference became distinctly marked. If nuclear spin is calculated from intensity considerations self-reversal has the effect of increasing the calculated spin. Minimising self-reversal by the above method, the nuclear spin of caesium has been found to be 5/2.

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*July*, 1933.

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## Aplanospore-formation in *Vaucheria uncinata* Kutz.

DURING our investigations of the Punjab Fresh-water Algæ, we came across a sheet of *Vaucheria uncinata* Kutz., in a pond called Mastiwal near Bodal in the Hoshiarpur District. Usually this species is found

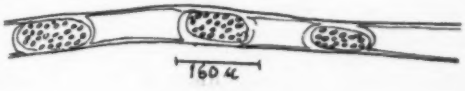


**Fig. 1.**

free floating in ponds and slowly flowing fresh-water streams but in this particular case a sheet of the alga was found partly

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* Lau and Reichenheim. *Naturwiss.* **20**, 49, 1932.
Wood. *Phil. Mag.*, **8**, 205, 1929.
Metcalfe and Venkatesachar. *Proc. Roy. Soc., A*, **105**, 520, 1924.
Venkatesachar. *Zs. f. Physik*, **75**, 676, 1932.

submerged in a drying puddle and partly exposed to dry air. Specimens were separately taken from both the parts and examined. It was found that filaments from the

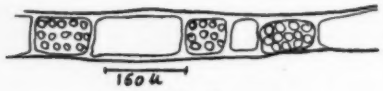



Fig. 2.

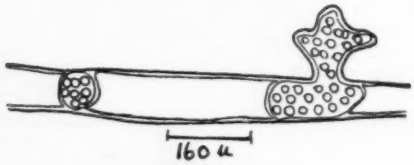



Fig. 3.

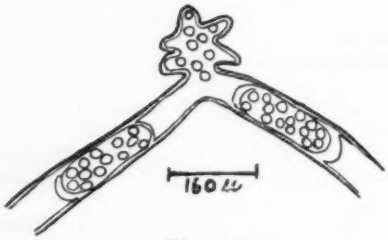



Fig. 4.

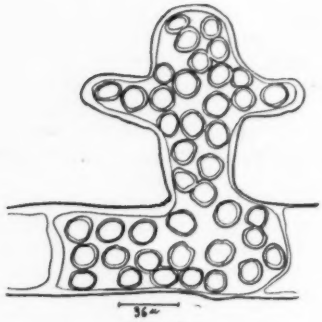



Fig. 5.

submerged parts were laden with oospores and antheridia, while in the exposed portion aplanospore-formation was dominant almost to the exclusion of the normal sexual process and replacing it in many cases. Extensive septum-formation takes place in the filaments so that they are cut off into coenocytes varying from 90 to 200$\mu$ in length (Figs. 1 and 2). These coenocytes later on become aplanosporangia, each containing from 8 to numerous rounded aplanospores with thick walls. The aplanospores average about 18$\mu$ in diameter and have a wall about 3$\mu$ thick. In many cases side branches which ordinarily bear oogonia laterally and an antheridium apically become filled with aplanospores (Figs. 3–5). One great peculiarity is the

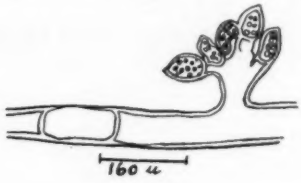



Fig. 6.

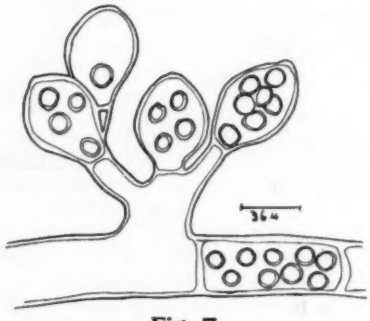



Fig. 7.

presence of aplanospores even in oogonium-like-structures, (Figs. 6 and 7) and in such cases it was seen that no antheridium terminates the bunch of these structures, so here we apparently see a case of replacement of sexual reproduction by a purely asexual mode of reproduction. In this case drought and unfavourable physiological conditions appear to be the cause of the change.

S. L. GHOSE.
M. S. RANDHAWA.

Government College,
Lahore,
*July* 1, 1933.

## Geology.

LET History tell of mediæval strife,
Of Roman Cæsars, Grecian art and life,
Of Egypt's Pharaohs, Babylonian kings,
And all the passing pomp of human things;
Thy still more potent sight, new-risen Muse,
Sees further back, and where Man's records fuse
Into dark obscurity, thy tongue
Takes up the tale. To aeons yet unsung
Translated are our musing minds enthrilled,
To wait in awed delight and watch God build
The universe; back to each mighty stage,
Written in stone, page by rocky page;
Back to the dim and vapoury birth of spheres,
When chaos ceased, and heavenly charioteers
Began their fiery circling course to run
In silence round the blazing parent Sun;
Back to the wat'ry growth of boiling seas,
From which emerged by unperceived degrees
Majestic continents, beside whose plains
Mountains slowly piled their folded chains,
While subtle rain and frost and wintry gales
Began the endless fretwork of the vales;
Back to the dawn of Life, whose quickening breath
Rescued Nature from the silent death
Of involition, irresponsiveness;
When lowly plants and creatures numberless
Began that ordered chain, whose latest link
Was forged when Man stood trembling on Life's brink,
And ope'd his wondering eyes, for weal or woe,
To all the pageant of this earthly show.
What dazzling binding drapes so perfectly
The volumes of thy lithic library!
'Tis not to wonder that there are who fail
To turn the page and read the endless tale:
Of cliffs that nameless oceans once assailed;
Of beaches o'er which sibilantly wailed
The tides of seas whose floor is now a chain
Of snow-capped peaks; of streams which o'er the plain
Once wound their fertile way toward the strand;
Of yellow deserts whose unwater'd sand
Whirled aloft, like some Titanic hone
Whipp'd its polished mark on rock and stone;
Of lava floods that set the sky ablaze;
Of stormy floods; of sunny summer days;
Of raining skies which left their weeping mark
On smooth and sandy strands: of glaciers stark,
Glimmering white 'neath bygone moons; of trees
And fruits and flowers; of birds upon the breeze;
Of marshy bogs with tall unwieldy weeds;
Of smiling eye-like lakes eyelashed with reeds:
Of shifting coasts begirt with crumbling screes;
Of sinking continents or shallowing seas.
Records of every force and every strain
That folded, twisted, rent and tore in twain
Earth's meagre envelope that scarce divides
Her breathing millions from her molten tides—
These are thy deathless themes, which, without end,
From infinite to infinite extend.
Clio's sister fair, to thee belong
A newer minstrelsy, an older song,
That never ends and never has begun—
The Earth—our Mother and our grave in one!

E. H. P.

## Cyst Formation in Plant Galls.

By M. S. Mani, *Entomology Section, Zoological Survey of India, Calcutta.*

HOW the irritation of the developing gall-maker gives rise to repeated cell-division, over-growth and consequent formation of galls, is but little understood. At one time it was held that the injury caused by the puncture in oviposition and in feeding gave rise to increased flow of sap and consequent increased cell-division and gall-formation. Such secondary changes alone do not give rise to gall-formation. While, in this connection, investigating the response of the vegetable tissues to the stimulus from the gall-maker, it was observed by the author that the morphological changes were preceded by complicated physiological ones. These latter are not passive but active changes brought about by the enzymatic secretions from the gall-maker. Where complete resistance and actual prevention of the irritation was not possible, adaptative changes occurred in the vegetable cells. Thus, in the case of the cynipid gall on *Quercus* sp., it is known that the cynip maggot produces a secretion containing two important enzymes, invertase and diastase. These act on the cells and dissolve them, which are then sucked up by the cynip larva. The tannin produced by the vegetable cells precipitates these two cell-dissolving enzymes, thus rendering them inactive. The tannin thereby acts as a barrier to the cell-dissolving activity of the cynip. It is itself, however, hydrolysed to gallic acid by tannase, another enzyme secreted by the cynip. This gallic acid changes to pyrogallol which is oxidised to purpurogallin by other oxidising enzymes, so that in the end tannin disappears totally in the place attacked by the cynip. This results in the dissolution by invertase and diastase of the vegetable cells. Such a series of complicated changes are accompanied by increased physiological activity of the vegetable tissue as is evidenced by the increased protoplasmic streaming and increased rate of respiration. The increased physiological activity brings about rapid mitosis and new cells are thereby formed, the rate of new cell-formation exceeding very much that of cell-destruction and hence the part grows.

Again in certain cases of parasitic fungus it is known that just in front of the advancing parasitic hyphæ the host cells are rapidly and thickly suberised so as to place a kind of barrier in the way of the attacking foe. This alone, however, does not constitute immunity or even resistance to diseases in plants, but an active, resistive, though inefficient effort on the part of the plant is clearly demonstrated. A somewhat similar adaptation in certain entomocecidia also has been observed by the author. The enzymes occurring in the secretion of the Itonid larva are found to give rise to ligninisation or suberisation of cell-walls. The Itonid larva by secreting enzymatic fluids dissolves and absorbs plant cells and thus bores a tunnel in the flesh of the gall. The cells surrounding this tunnel become thick-walled, heavily suberised or ligninised as the case may be. Such suberized or ligninised cells are not dissolved by the secretions of the larva. Gradually this process spreads to several layers of cells, beyond the ones immediately lining the cavity of the tunnel, so that in due time the Itonid larva is completely enclosed in a hard, brittle, fistular structure, which is either completely closed or opens to the outside on the surface of the gall. The Itonid which by this time reaches, in the majority of such cases, the pupal stage, thus appears as if it were encysted in the flesh of the gall. In many cases of parasitism by worms, as in *Tinea solium* in the flesh of pig, it is generally known that due to some kind of irritation of the presence of the foreign body the muscular tissue of the host secretes a shell or cyst in which the worm is completely enclosed. By analogy, the hard fistular structure formed round the Itonid in the flesh of galls described above may also be called *cysts*.

The cyst, being made up of dead and thickened cells, appears to act as a kind of mechanical, perhaps also physiological, barrier to the irritant activity of the Itonid, so that after suberisation or ligninisation (cyst formation), active cell proliferation (the abnormally rapid cell formation by mitosis) is nearly brought to a standstill and the gall practically ceases to grow. Cyst formation begins at different periods in different galls. When it is complete before the Itonid pupates, the growth of the gall is arrested and the gall is relatively

small. This however does not appear to be the case always and then the size of the gall is not in any way affected by the presence of cysts.

Cysts are not formed in every gall. In fact, galls may be divided into two distinct classes as *cystiferous* or cyst-bearing and *acystiferous* or non-cyst-bearing. Examples of the former class are the shoot galls of *Cephalandra indica* Nees, *Pongamia glabra* Vent., *Melothria heterophylla* Cogn. and leaf galls of *Odina wodier* Roxb. (all by undescribed Cecidomyidæ) and also the leaf galls of *Mangifera indica* Lin. by *Oligotrophus mangiferæ* Felt. Examples of the latter class are shoot galls of *Momordica charantia* Lin. by *Lasioptera falcata* Felt. and the fruit gall of *Pongamia glabra* Vent. by *Asphondylia pongamiæ* Felt. The cysts of the shoot gall of *Melothria* and *Cephalanda* are longitudinal, sinuous, cylindrical tubes, made up of suberised cells. The cyst in the shoot gall of *Pongamia* is a short, stout, hard tube of ligninised cells. That of the leaf gall of *Odina* is a hard L-shaped, cylindrical structure opening on the surface of the gall and made up of ligninised cells.

Though this extremely interesting structure appears to have been observed by various previous workers, its true nature is not yet understood. The correlation between this curious structure and the growth, shape, size, etc., of the galls bearing them is under detailed investigation and the author hopes to report more about this on some future occasion.

## Notes on Some Hydro-Electric Schemes in India.

By Dr. Ram Prasad.

IN these notes an attempt is made to point out some of the important features of Hydro-Electric development in India giving some details of a few of the systems. The development of power in the Mysore State is dealt with first, to show what can be accomplished in public service utilities through Government agency. Next, the two major Hydro-Electric schemes are described which were recently put into service, one in Northern India and the other in Southern India by the respective local Governments and are intended to help forward the industrial and incidentally agricultural development of the provinces by providing a plentiful supply of moderately cheap power over a wide area.

The localities where Hydro-Electric Power is generated in India may be divided into four sections:

(1) The Northern and Sub-Himalayan section including the Ganges canal network.
(2) The West Coast section near the Ghats.
(3) The Southern part of Deccan Plateau.
(4) The Southern section from the Nilgiri Hills downwards.

Under section (1) may be included:

(*a*) The Uhl River Hydro-Electric Project of the Punjab Government near the Himalayan foothills which will serve the Punjab. This scheme was started in 1926 and the 1st stage of 48,000 E.H.P. was put into service in March 1933.

(*b*) The Ganges Canal and Ramaganga Scheme of the Government of the United Provinces of Agra and Oudh which utilize the canal falls of the famous Ganges river canal systems. This scheme of 3,500 E.H.P. was put into service in 1931 and is intended to serve the western and middle section of U. P.

Under section (2) we may include the Hydro-Electric Power systems organized by Messrs. Tata & Sons of Bombay. This big network obtains its power from three generating stations which derive their water from artificial lakes constructed on the Western Ghats and supply the power requirements of Bombay, Poona and the surrounding territory including the G.I.P. and B.B. & C.I. Railways, through numerous sub-stations and transmission lines. The initial stages of the scheme were put into service before 1914 and the system has been gradually extended to its present capacity of about 250,000 E.H.P.

Under section (3) comes the Cauvery Power Scheme in the Mysore State which is the oldest Hydro-Electric system in India and derives its power from the waterfalls of the Cauvery near Sivasamudram where the Mysore plateau descends to the plains. This scheme was started in 1902 with a capacity of 5,000 E.H.P. mainly to supply

power to the Kolar gold mines and has been gradually extended to meet the increasing demand of the mines and other growing industries in the State and has a capacity of 46,000 E.H.P. at present.

Under Section (4) comes the Pykara Hydro-Electric Project of the Madras Government on the slopes of the beautiful Nilgiri Hills. The scheme was begun in 1926 and the first stage of 22,000 E.H.P. was put into service in April 1933. This is intended to serve the industrial and agricultural districts of southern Madras Presidency and to link up with other projects that may be undertaken in Madras later on.

Besides these major Hydro-Electric schemes there are various small systems scattered in the Bombay Presidency, Tea Estates in south-west Madras, and on the Himalayan borders of Assam and Bengal. There are many undeveloped areas with possibilities of major schemes which in years to come will provide large blocks of power for the industrial and rural requirements of India.

The following statement gives some useful data regarding the major schemes now in service:—

| No. | Name of the Scheme | Province | Height above Sea Level of Forebay | Head in feet used | Station Capacity | Quantity of Water required | Main Transmission Voltage | Other Details |
|---|---|---|---|---|---|---|---|---|
| 1 | Cauvery Power Scheme (C.P.S.) | Mysore State | 2,000 ft. | 410 ft. | 46,000 E.H.P. | 1,200 cusecs | 76,000 & 37,000 volts | Francis Reaction Turbines |
| 2 | Tata Power Co. Group | Bombay Presidency | About 2,500 ft. | About 1,000 ft. | About 250,000 E.H.P. | 3 stations each about 600 to 800 cusecs | 110,000 volts | Impulse Wheels |
| 3 | Ganges Canal & Ramaganga Schemes | United Provinces | About 500 ft. | 6 to 12 ft. | 3,500 E.H.P. (I stage) | 4,000 to 8,000 cusecs | 37,000 volts | Francis Reaction Turbines (Vertical) |
| 4 | Uhl River or Mandi Hydro-Electric Project | The Punjab | 6,000 ft. | 1,800 ft. | 48,000 E.H.P. (I stage) | 150 cusecs | 132,000 & 66,000 volts | Impulse Wheels |
| 5 | Pykara Hydro-Electric Scheme | Madras Presidency | 7,000 ft. | 3,080 ft. | 22,000 E.H.P. (I stage) | 60 cusecs | 66,000 volts at present (later on 110,000 volts) | Impulse Wheels |

THE CAUVERY POWER SCHEME.

The Cauvery Power Scheme (C.P.S.) was started by the Government of Mysore in 1902 primarily to supply power to the gold mines at Kolar, at a distance of about 90 miles, with a generating capacity of about 5,000 E.H.P. and power was transmitted at 35,000 volts. During the last 30 years, as the demand for Kolar increased and new demands came up in Bangalore and Mysore, the capacity of the Generating station, Transmission lines, and the sub-stations was gradually increased, so that to-day the capacity of Sivasamudram Station is 46,000 E.H.P. and the voltage of power transmission is 76,000 volts.

Being a medium head development (410 ft.) the original turbines of the Impulse type have been gradually replaced by the latest type of Reaction Turbines (Francis) equipped with suitable oil pressure governors. As the Cauvery river is laden with fine silt and sand several experiments had to be carried out in co-operation with the turbine manufacturers to minimise the wear and tear of the runners and wickets and suitable designs were arrived at and adopted. The question of "Erosion" of the turbine runners due to the liberation of nascent oxygen from the water under partial vacuum has also been successfully tackled by electric welding, and a modified design has also been adopted using chrome nickel steel for the manufacture of the runners. Similarly based upon local experience the design of the transformers and switch-gear have been modified to suit the

requirements. Even this year, in order to increase the overall efficiency of the power station and also to increase the overload and stand-by capacity a new turbine and generator (8,000 E.H P.) are being installed and will replace three impulse wheel machines of a total 6,000 H.P capacity. The latest design of fabricated steel frame is being used for the generator and some improvements in the turbine design has also been effected. When this is completed the effective capacity will be given by:—

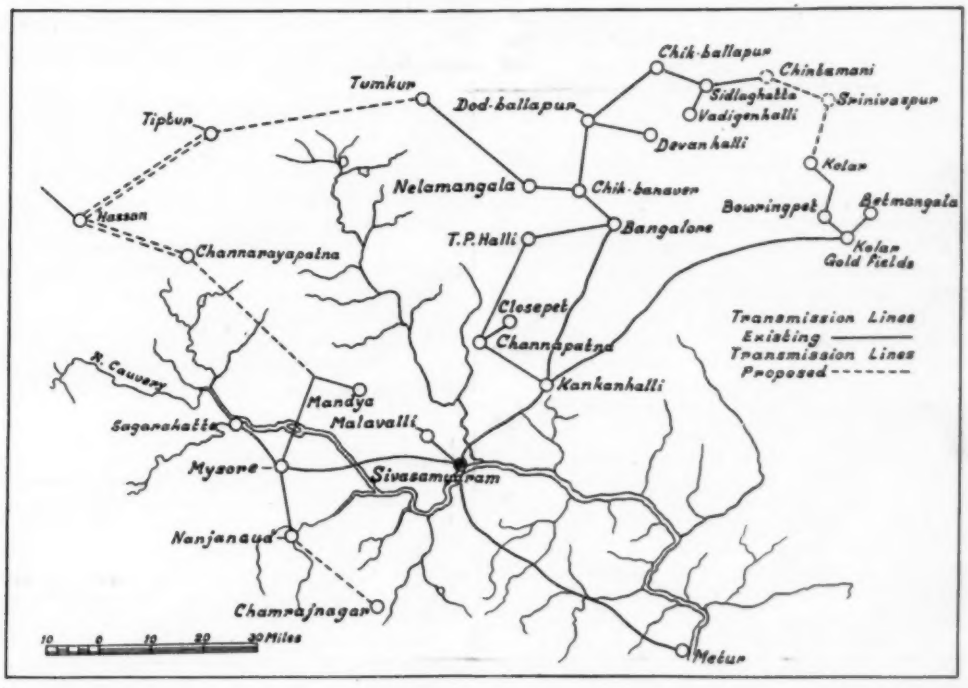
3 Generators of 8,000 E.H.P. each coupled to 9,000 B.H.P. reaction turbines and 7 generators of 4,000 E.H.P. each coupled to 5,600 B.H.P. reaction turbines. Power is generated at 2,200 volt, 3 phase 25 cycles and is stepped up to 76,000 volts by means of 5 Banks of Transformer of which 3 are of 10,000 KVA each, and 2 of 5,250 KVA each at 85% power factor.

Efficient and close regulation of the turbines by suitable governors and the voltage regulation of the generators by automatic voltage regulators enable easy handling of sudden peak loads (hoist load of mines) of nearly 3,000 H.P. without any appreciable change in the frequency or voltage at the receiving end.

From the Sivasamudram Power Station there are six main transmission lines of which two are for Kolar at 76,000 volts, and two carry the power at 76,000 volts to Kankanhalli, about half-way between Sivasamudram and Bangalore, where three Banks of Auto-Transformers step down the voltage to 37,000 volts for transmission to Bangalore over duplicate lines. Another two lines designed for 76,000 volts (now working at 35,000 volts) carry the power to Mysore where there is provision to link up the system with another power station that may be built at the Cauvery Reservoir about 10 miles from Mysore (Krishnaraja Sagara).

There are also two temporary lines at 37,000 volts now supplying power to Metur where the Madras Government are constructing a huge dam lower down across the Cauvery River for purposes of irrigation.

The following table may be interesting:—



| Sub-Station | Distance from Gen. Stn. | Normal load as measured at Gen. Stn. | Type of Load |
|---|---|---|---|
| Kolar | 95 miles | 25,000 E.H.P. | Mining load including deep mine hoists, water pumps, air compressors, crushing and mechanical load and general lighting all over. |
| Bangalore | 65 miles | 13,000 E.H.P. | Textile mills, oil and flour mills, saw mills, minor industries, irrigation pumps, city water supply, and general lighting all over. |
| Mysore | 35 miles | 4,000 E.H.P. | Textile mills, rice mills, oil mills, saw mills, city water supply, minor industries, irrigation pumps and general lighting all over. |
| Metur (Temporary) | 63 miles | 2,400 E.H.P. | Concrete mixers, hoists, mortar mills, stone crushers, water pumps, water supply and general lighting all over. |

There is a future demand for power in the western and north-western sections of the Mysore State where there are big tropical forests and moderately high mountains where coffee and tea plantations are coming up. Possibilities for the manufacture of pulp and paper out of bamboo or other suitable trees are very favourable and will require large blocks of power. If conditions permit the power lines may be extended to this area and also supply power to the Mysore Iron Works for driving their motors and if possible for smelting purposes. Later on if power demands justify it, another generating station of about 30,000 or 40,000 E.H.P. may be constructed at the north-western corner of the State by harnessing the Sharavati River near Jog Falls (910 ft.), one of the highest falls in the world.

By means of medium voltage (4,600 volts) and low voltage (2,300 volts) networks, nearly the whole of the southern and eastern part of the Mysore State has been electrified and power is being used for irrigation pumps and general lighting in nearly 25 small towns and 50 villages. The final supply to the consumers is at 220 volts by step-down transformers.

Before long this number will be increased many times and electricity will serve even the humblest villages in this area. This is very desirable as Mysore has no coalfields, oil-wells, or even a seaport to import fuel at low rates.

Continuity of service to the consumers is a very important feature which is maintained by means of double or quadruple circuit power lines, suitable sectionalizing stations, and automatic switching and protective equipment of the most up-to-date design. At the important sub-stations which derive power over long distance transmission lines such as Kolar and Bangalore suitable synchronous motors (condensers) have been installed for improving the power factor of the load and incidentally limiting the voltage fluctuations within reasonable limits. Distribution of energy is done through 2,300 volt, 3 phase 25 cycle power lines in towns and cities and through 4,600 volt, 3 phase 25 cycle power lines in rural areas.

The C. P. S. being a Government concern, power is supplied directly to the ultimate consumer so that the cost of retail power supply is kept low and in case of need, all the resources of the Electric Department are available for keeping up the service or effecting repairs, etc. The localities served by the Cauvery power are inhabited by communities in various stages of civilization and culture and it is remarkable how the so-called illiterate and apparently backward agriculturists and farmers have taken to electricity to replace manual and bullock power. The ancient and crude appliances are being replaced by up-to-date equipment and the earning capacity of the farmers has been appreciably increased. Small land-holders purchase electrically-driven pumps from the Government on easy hire purchase system and earn decent profits from their 5 or 10 acres of land on which are grown potatoes, onions, ordinary vegetables, flowers and sometimes fruits and sugarcane. Even domestic cooking by electricity is becoming popular in some towns, the cost of energy being $\frac{1}{2}$ anna per unit for this purpose whereas it is 1 anna for general

rural power supply for 10 H.P. or less. At present the entire staff of the Cauvery Power scheme is manned by Indian engineers and workers who have had suitable technical training in India and abroad. The latest developments in the design of machinery and equipment are carefully studied by the technical staff and every opportunity is availed of to bring the power station and transmission line maintenance and operation up-to-date. Recently a 37,000 volts system was successfully linked with the major 76,000 volts network by means of star-connected auto-transformers equipped with delta-connected tertiary windings that eliminate the higher harmonics. Differential current relay protection for generators and transformers, balance current and reverse power relay protection for the transmission lines, cut off faulty apparatus or power lines from the other good sections, and help easy location of faults, quick repairs and effective service. The insulators for the transmission lines are installed after rigorous tests and the design of the lines aims at a high factor of safety at reasonable costs. Suitable bird guards, locally made, have effectively eliminated the troubles from birds on the power lines.

During recent years investigations were carried out to utilize the tall varieties of trees grown in the Mysore forests, for transmission line supports, and a special species (Balega) which is white-ant proof has been found satisfactory after tests. These poles are now being used after they are creosoted with creosote oil manufactured by the Mysore Iron Works.

The manufacture of porcelain insulators required by the Electric Department, has been undertaken by Government and the requirements are being supplied. In this connection the co-operation and help of the Indian Institute of Science with regard to the electrical and mechanical tests has been very valuable. Attempts are being made to fire the insulators in electric kilns.

For the distribution system, step-down transformers are being made by the department in their own laboratories successfully.

The C.P.S. has been progressive since its inception and has pioneered in many respects. There is field for expansion in the matter of electro-chemical industries and electrification of railroads.

### THE UHL RIVER OR MANDI HYDRO-ELECTRIC SCHEME.

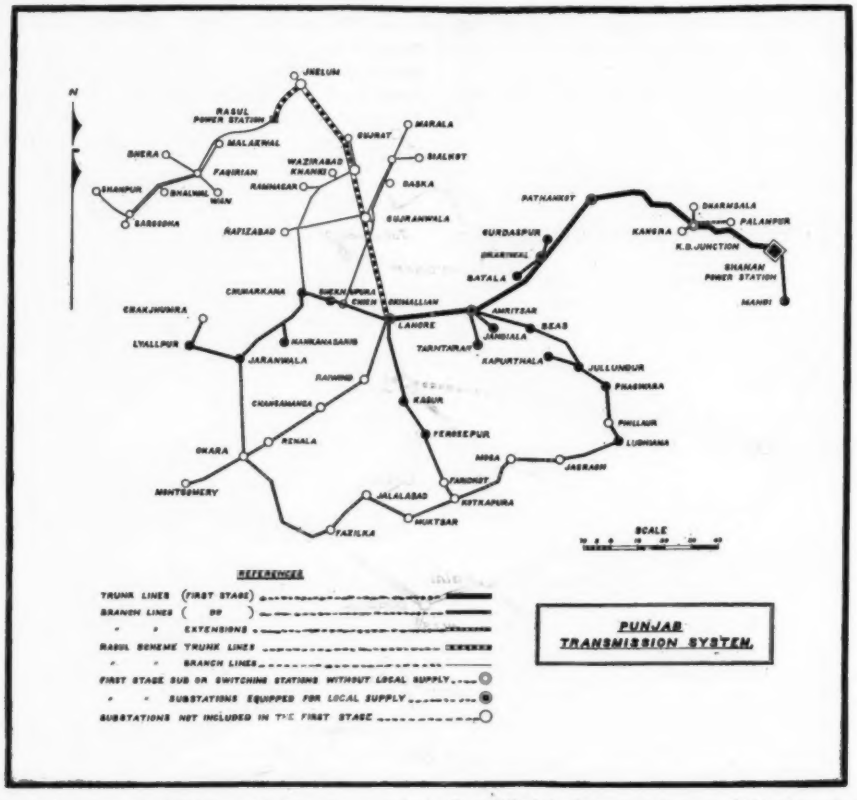
This power scheme put into service in March 1933 is located at Jogindernagar and derives its water power from the snowbound Uhl River, a tributary of the Beas in the Punjab, where, diverted for power, the Uhl River runs at an elevation of about 6,000 ft., and a tunnel about 2¾ miles long had to be driven through the hill to take out the water to the outer slope where a head of 1,800 ft. could be obtained. Further drops of 1,200 ft. and 750 ft. are available lower down and will be utilized later when required.

The project has been designed for 48,000 E.H.P. in the first stage of development based on the natural flow of the river, about 150 cusecs, not reinforced by storage. The ultimate capacity is expected to be about 96,000 E.H.P. when a reservoir for the storage of 2,000 million c.ft. of water is constructed. If the power stations at the two lower slopes are constructed their capacities will be 64,000 E.H.P. and 40,000 E.H.P. respectively. The combined ultimate output of the 3 power stations would then be 200,000 E.H.P. Compared with the three Tata Schemes near Bombay with an aggregate installed capacity of 250,000 E.H.P., which form the largest group of Hydro-Electric undertakings in India, the Uhl river scheme stands second in order of power output with an installed capacity in its first stage of 64,000 E.H.P. When developed to its final stage it will rank as one of the major schemes in the world.

In the power station are now installed 4 generators each of 16,000 E.H.P., 11,000 volts, 3 phase 50 cycles 428 R.P.M. driven by single jet pelton wheel turbines. The step-up transformer equipment comprises two banks of transformers each of 24,000 Kw. 11,000/132,000 volts and of the outdoor type. This is the first scheme in India to transmit energy at 132,000 volts, the highest hitherto attempted being that of the Tatas at 110,000 volts. Double circuit transmission lines at 132,000 volts are laid out from Jogindernager to Lahore—a distance of 173 miles—and branch lines are also laid out operating at 66,000 volts from Amritsar to Ludhiana (88 miles), Lahore to Lyallpur (89 miles) and to Ferozpur (50 miles).

In about 15 towns a complete system of local distribution is provided by which retail supply is given direct to the consumers similar to C.P.S. in Mysore. But in those localities where there are already licencees, power will be supplied in bulk to

the licencees, for distribution as in Lahore, Amritsar and Jullundher. A bulk supply to Kapurthala and other neighbouring States will probably be taken very soon.




The primary object of this scheme is stated to be to give effect to the desire that Government should help forward the industrial development of the province by providing a plentiful supply of cheap power over a wide area. The Punjab possesses no coal of commercial value and the cost of imported coal is about Rs. 25 per ton, more than half of which covers freight charges.

When the branch lines are extended to rural areas as in Mysore, it is hoped that power will be taken up by agriculturists for pumping water in non-irrigated tracts and also for the relief of water-logged areas and for farming operations. Supply is being offered for industrial purposes on a tariff which by its terms will continuously favour the consumer who uses electricity in increasing quantity.

### THE PYKARA HYDRO-ELECTRIC SCHEME, MADRAS.

The present scheme makes use of the waters of the Pykara River which drains the Nilgiri plateau at an altitude of about 7,000 ft. about 15 miles from Ootacamund. At the northern edge of the plateau the river drops to nearly half its altitude, within a short distance making up a total maximum head of about 4,000 ft. available for power. But at present only a head of about 3,080 ft. is utilized for power purposes. The catchment area of the river is about 38 sq. miles receiving an average rainfall of 80 to 100 inches. The amount of water flowing in the river in different parts of the year is variable, ranging from 20,000 cusecs in July to 15 cusecs in May. Hence the necessity of a storage reservoir to supply the average quantity of water required for power. If the full extent of the reservoir capacity be developed (3,000 million ft.), about 90,000 H.P. can be developed at the

Pykara station, and 30,000 H.P. from the tail water at a site a few miles below the main power house.

The first stage put into service in April 1933 utilizes a head of 3,080 ft. to develop a maximum of 22,000 E.H.P. using about 60 cusecs. The storage reservoir now constructed impounds about 84 million c.ft. It may be noted that the Pykara scheme is the highest head plant in the British Empire including North and South America and believed to be one of the 5 highest head plants operating anywhere in the world. The total length of the pipe line from the forebay to the generating station is about 10,000 ft. made up of sections of 27", 24" and 21" pipes.

The generating plant consists of three units each consisting of 10,900 B.H.P. impulse turbines driving an alternator 7,810 KVA. at 11,000 volts, 50 cycles, 600 R.P.M. Provision has been made for the installation of 4 bigger units each of 17,000 H.P. For stepping up the voltage to 66,000 volts, at present there are 2 banks of transformers each 7,810 KVA. 11,000 volts' 66,000 volts' 110,000 volts. In the later stages when the power demand increases the voltage of transmission may be increased to 110,000 volts.

For the present the main centre of load is expected to be Coimbatore, about 50 miles from the power house and the transmission in voltage at present is 66,000 volts. All

the transformers, switch-gear and lightning arresters are of the outdoor type. The receiving station at Coimbatore is also of the outdoor type and contains 4 banks of transformers each of 3,000 KVA. 66,000 volts' 22,000 volts' 11,000 volts. A double circuit 66,000 volts transmission line leads to Tiruppur and Erode, which at present are operating at 22,000 volts. In addition to this there are sub-stations at Erode, Tiruppur, Pollachi, Palghat and Iyerpad; the last one for tea factories in the Annamalais. Erode is connected to Salem and Metur and Pykara to Ooty directly.

There are possibilities of power being taken to Cochin, Travancore, Madras and Trichinopoly. When Metur Power Station is linked with Pykara, a 110,000 volt line will supply power to Madras City also.

## Diffusion of Diseases.

THE League of Nations Regional Health Conference which met at Cape Town in November last year discussed the extension of yellow fever beyond barriers heretofore effective, but rendered possible by the improved methods of travel by railway trains, aeroplanes and motor cars. Major-General J. D. Graham's report points out the danger of the extension of this disease from West Africa to East Africa and from there to the Asiatic countries, and emphasizes the need of adopting suitable measures to combat the possibilities of the introduction of this new scourge into India.

(Almost every mechanical invention seems to contain the germs which endanger human life and we realize the risks only after the invention has been harnessed for the service of mankind. The steam engine which introduced the industrial revolution, possessed enormous potentialities for opening up the countries for economic and cultural development and few could suspect at the moment that railway service would become the means for the spread of diseases. Wherever man moves, he carries with him obviously, in spite of the greatest precautions, the vectors of disease and especially where services are introduced for carrying large masses of population occupying different hygienic levels, the danger of a rapid spread of infection, is real and acute. If railway trains are intended to promote wider human intercourse, to develop trade and commerce, to carry knowledge and civilization to remote parts of the country, they have been the effective means of equalizing the incidence of diseases also. In spite of the utmost precautionary measures, diseases escape the vigilance of custom house offices without paying the duties. Nature seems to mock at us in our efforts to secure only the good and eschew the bad and if the facilities of rapid transport confer a boon on us, we have to be prepared to accept the evils brought in its train. Medical research and the quarantine regulations may mitigate their severity but cannot avoid them.)

Probably in the case of yellow fever we have in our power the means of effectively combating its extension. We know the breeding habits of the different species of mosquitoes and the researches of the Ross Institute have placed at our disposal the remedial measures for controlling or destroying the entire mosquito population. Malaria is now well under control and Medical Science should be engaged not only in restricting the spread of yellow fever but in totally wiping it out, for so long as it is permitted to exist even in remote and isolated tracts, its extension to wider areas is almost a certainty. Civil aviation which links up the large towns where sanitary arrangements are satisfactory, is not the real source of danger, but flights undertaken to establish records and those in the nature of sensational stunts constitute a real menace, especially when there is a forcible landing in inhospitable and disease-ridden country. (In India, the introduction and rapid extension of bus traffic, which has undoubtedly opened up the country side, has become the means of disseminating diseases. The problems of cultural development and the promotion of commerce and trade are closely associated with those of the preservation of health and physical efficiency of man and Science cannot afford to relax its vigilance or view with detached interest the rapid extension of traffic in the country.)

## Proteins and Proteoclastic Enzymes.

THAT the properties of a protein are not a simple summation of those of its constituent amino acids is the theme of a course of three lectures on "The Chemistry of Proteins" delivered by Prof. Max Bergmann of Dresden, at University College Hospital, Medical School, London, in January last (*Nature*, **131**, 662, 698, 1933). The behaviour of the amino acids in proteins are influenced by the peptide linkages, and *vice versa*. Prof. Bergmann arrives at these conclusions from a study of the reactions of a few amino acids, whose zwitterionic character has been so modified as to simulate their condition in the peptide molecule. Thus, on acetylating an optically active amino acid, it easily suffers racemisation under the catalytic influence of acetic anhydride. As an intermediate enolisation $R \cdot CH(NH.OC.CH_3) \cdot COOH \rightarrow R \cdot C(NH \cdot OC \cdot CH_3) : C(OH)_2$ alone can explain the racemisation, this is possible only by the peptide linkage of the acetylated compound influencing the $\alpha$-hydrogen. The corresponding chloroacetylated compound retains its optical activity under similar treatment. As other examples of the mutual influence of the peptide linkage and amino acid may be cited, *inter alia* (i) the *in vitro* experiments to show the conversion of an amino- to a keto- acid through dehydrogenation and *vice versa*, and (ii) the reactivity of arginine on acetylation and simultaneous dehydration; the triacetyl anhydroarginine thus obtained easily yields with sarcosine, for example, creatine and a derivative of ornithine, while in presence of cold water, the compound readily hydrolyses to acetyl derivatives of ornithine and urea.

To a better understanding of the mutual influence referred to above, a number of peptides have been prepared with the use of the acid chloride of benzyl carbonic acid, obtained by treating benzyl alcohol with phosgene. The *modus operandi* is as follows: acid chloride of benzyl alcohol+amino acid→benzyl carbonato amino acid (A); A→corresponding acid chloride or azide (B); B+another amino acid→benzyl carbonato peptide (C); $C \xrightarrow[\text{Palladium Black}]{\text{hydrogenated}}$ toluene, carbon dioxide and the peptide, the final step of the process avoiding all risks of peptide scission. This method has not only made possible the preparation of even those peptides whose synthesis has been a failure hitherto, but all the peptides are obtained in their optically active condition, which is a very distinct feature of the method. The peptides thus prepared have been subjected to the action of enzymes, which, because of their specific nature, have been employed to decide the mode of linkages therein. The synthetic peptides under the several influence of dipeptidase, amino-polypeptidase, and trypsin, behave in the anticipated manner. Not all the dipeptides are attacked by dipeptidases, nor are they, in all events, the specific substrates for the latter enzymes. As illustrations of these findings may be mentioned, notably the resistance of asparagyl-tyrosine to all intestinal proteolytic enzymes but the ready hydrolysis by peptidase of the closely allied compound glutamyl-tyrosine; the hydrolysis of tyrosyl-tyrosine not only by dipeptidase but also by carboxy-polypeptidase and the inactivity of dipeptidase towards glycyl- and alanyl prolines and their hydrolysis by amino-polypeptidase. They show at once the extent to which the amino acid residue influences the peptide linkage to enzyme attack and the need to revise enzyme nomenclature. Again, an unsaturated peptide like glycyldehydrophenylalanine is unattacked by dipeptidase despite the presence of a normal peptide linkage in the compound. The corresponding dehydrodipeptidase, however, has been shown to exist in the kidney: through the action of this enzyme a possible mechanism of a part of protein metabolism has been suggested.

The question now arises whether linkages other than the normal peptide ones occur in the protein molecule. Though proteolysis generally results in a release of equivalent amino and carboxyl groups pointing to the existence of normal peptide linkages, illustrations of other types of linkages are not wanting. On comparing the successive actions of trypsin and intestinal peptidase on gelatin with the enzymic hydrolysis of proline peptides, it results that a large portion of proline in gelatin is combined through its imino group. Difficulties inherent to heterogeneous systems as prevailing in the enzymic hydrolysis of natural proteins, have largely impeded the proper understanding of the mode of action of proteinases. An ingenious method, no doubt, has been developed to establish that the course of enzymic digestion of gelatin spread in a thin film of uniform thickness, follows the Schütz's rule. But methods of far wider application have yet to be evolved for a fuller and a more perfect understanding of the structure of proteins and the action of proteoclastic enzymes.

M. SRINIVASAN.

## The Indian Mathematical Society.

THE Indian Mathematical Society has completed the first twenty-five years of its existence and the Silver Jubilee Conference was held in Bombay in December last.

In order to enlarge its activities and serve the needs of students and teachers of mathematics, it has been decided to issue two quarterlies in place of the "Journal of the Indian Mathematical Society" published hitherto. In 1933, the Journal will appear as the Jubilee Memorial Volume containing an account of the Eighth Conference held at Bombay and the Jubilee Celebration. The second quarterly is issued under the name of the "Mathematics Student" and we have received Vol. I, No. 1 of the new Journal. In a foreword, it is stated that this will seek to stimulate interest, encourage wide reading and a critical appreciation of results. It will be the official organ of the Society for all announcements and will attempt to keep its readers in touch with the mathematical world of India and abroad. It will devote itself to raise the standard of mathematical instruction in the country and provide a medium for exchange of ideas.

The first number of the new "Mathematics Student" contains an article on "Some Glimpses of Ancient Hindu Mathematics" by A. A. Krishnaswamy Ayyangar and another on "On Conics having a common Self-Conjugate Triangle" by K. Satyanarayana. There are notes and discussions as also questions and solutions that formed a regular feature of the Journal. We wish the Society a long and prosperous career of increasing usefulness.

## The Calcutta School of Tropical Medicine.

THE annual report (1932) of the above institution and the Carmichael Hospital for Tropical Diseases which has just been issued is a highly valuable document representing the progress of a large section of medical research in India. The report of the Director (Lt.-Col. H. W. Acton) reviews, in broad outline, the expansions in the different departments, new researches undertaken and the more important results obtained. Among the expansions, mention should be made of the opening of the All-India Institute of Hygiene and Public Health under the direction of Lt.-Col. A. D. Stewart. It is also refreshing to note that although the year was one of all-round financial distress, the different researches were not cramped for want of funds. In addition to the India Government and the Government of Bengal, the Indian Research Fund Association, the Indian Tea Association, the Indian Jute Mills Association, the Calcutta Corporation and other institutions, as also a few private individuals, contributed generously and helped the School to tide over a difficult period.

The report of the Director is followed by more detailed contributions from the heads of the departments. The Superintendent of the Carmichael Hospital records some peculiar clinical cases that came to his notice. The Professor of Tropical Medicine (Dr. S. P. Bhattacharjee) and his staff paid special attention to problems relating to tropical splenomegaly and cirrhosis of the liver in infants. The department of Bacteriology and Pathology under Lt.-Col. H. W. Acton devoted considerable attention to the origin and nature of phagedenic ulcers (Naga Sore), diagnosis and treatment of human carriers of dysentery, correlation of bacteriological examination of stools with their clinical significance, Vitamin B content of food in relation to the incidence of epidemic dropsy and a number of skin diseases. A cheap and efficient nutrient medium using the papain digest of the green mung dal (*Phaseolus mungo*) in place of peptone water and meat broth has been developed. The work of the department of Protozoology under Lt.-Col. R. Knowles included routine work relating to the examination of pathological products as also to the extension of the work on (*a*) transmission of the malaria in different areas, and (*b*) the human and the monkey malaria by numerative and cultural methods. Atebrin, the newly introduced synthetic preparation, has been tried on all the three species of human malaria with highly satisfactory results.

In the department of Serology and Immunology a number of laboratory tests for clinical purposes were standardised under the direction of Lt.-Col. R. B. Lloyd.

The report of the Professor of Pharmacology (Lt.-Col. R. N. Chopra) presents several interesting features. The work on snake venoms has shown that there is no justification for their use as either cardiac stimulants or for the treatment of epilepsy, insanity, asthma and such like diseases for which they are recommended in Indian Medicine. Studies on musk have shown that its fame as a cardiac tonic is not fully justified and that the therapeutic uses of that drug as cardiac and respiratory stimulant have generally been over-rated. An investigation into the absorption and therapeutic effects of Makaradhwaja have shown that its tonic properties correspond to those of minute quantities of mercuric chloride: it would appear therefore that it is an insoluble preparation of mercuric sulphide which is acted on by the gastro-intestinal juices so that minute quantities of mercury pass into the ionic condition to produce the characteristic tonic effects. These observations do not, however, fully dispose of the fact that the use of even highly purified mercuric sulphide in place of Makaradhwaja often leads to mercurial poisoning. Work on various indigenous drugs as also chemotherapeutic studies and biological assays on a number of substances sent from various parts of the country have been reported.

The department of Entomology (Dr. C. Strickland) reports several studies on malarial mosquitoes—particularly *A. stephensi* as also other disease-carrying insects. The report of the Professor of Public Health Laboratory Practice (Dr. B. B. Brahmachari) contains a few interesting features among which mention should be made of studies in the Vitamin A contents and nutritive values of ghee and different vegetable oils. The researches on ghee would appear to require more extended observations with specimens from different sources before any generalisations could be made. The proposed survey of the fæcal flora is interesting but, in view of the inadequacy of the present-day methods of isolating and studying different organisms, it is hardly likely that any new improvements in the detection of sewage pollution of water could be effected.

The recent success of Napier and his co-workers in the transmission of Kala-Azar to Hamsters through the bite of sand flies has placed the inquiry on a sounder basis, but further work is needed to elucidate certain obscure aspects of that disease. Of special interest is the fact that the suspected carrier, *Phlebotomus argentipes* is entirely absent from at least one heavily infected area in Madras and that in the Rameswaram island where a great deal of anti-malarial work has been carried out, Kala-Azar has almost entirely disappeared.

The Professor of Chemistry (Dr. S. Ghosh) reports on his works on indigenous drugs and Vitamin B assay of Indian rice. In the latter case close correlation between results obtained by Spruyt's colorimetric method and feeding experiments with birds was observed.

In the Hookworm Research Department Dr. Maplestone and his associates found that the newly introduced anthelmintic hexylresorcinol was not so efficient as other drugs already in use: moreover, it appeared to be highly toxic under certain conditions of administration.

The enquiry of bowel diseases devoted considerable attention to the characterisation of different types of cholera phages. Some preliminary work on the nature of cholera toxin showed that it contains some compound with a free cyanogen radical. There is a suggestion that the poisoning of the human system is due to the absorption of hydrocyanic acid or one of its

related compounds together with other toxic amines.

The Leprosy Department under Dr. Muir extended its observations on the pathology and bacteriology of that disease. The intradermal method of giving hydracarpous injections has been found to be more effective than the intramuscular or the subcutaneous treatments. The lack of correlation between the lesions and the number of *M. lepræ* was the subject of careful research and the evidence so far obtained suggests that there is a minute form of the parasite which has not yet been recognized microscopically and that this germ is the usual cause of at least early nerve lesions. The nature of this virus and the possibility of its being filtrable are discussed, analogy being drawn to a filtrable virus in rat leprosy and tuberculosis stated to have been demonstrated by some workers. Although claims have been made by workers in other countries that the leprosy organism has been isolated, yet repetition of their experiments has invariably led to negative results. The department has also conducted extensive propaganda and issued the quarterly Journal, *Leprosy in India*.

In the Diabetes Research Department, Dr. J. P. Bose carried out studies on the distribution of sugar in the blood of diabetic and non-diabetic subjects as the result of which it has been concluded that (1) in normal healthy subjects the plasmic sugar is only slightly higher than the corpuscular sugar, while in diabetic subjects the plasmic sugar is always much higher than corpuscular sugar, and (2) the high plasma and the low corpuscular sugar is due to the inability of the corpuscles to take in sugar from the surrounding plasma.

The Filariasis Research Department under Dr. S. Sundar Rao investigated problems relating to (*a*) longevity and (*b*) different modes of infection with *Wuchereria bancrofti*. Several methods of treating the infection with compounds of copper, bismuth, tin, zinc and lead were tried but without success.

The report of Respiration Diseases inquiry (Lt.-Col. Acton) relates to a survey of different diseases affecting persons engaged on tea gardens or jute mills. Since a large number of mill hands suffer from asthma, considerable attention was directed to the early diagnosis of the different types of that disease. In the tea gardens, pneumonia is responsible for many deaths and a study of the nature of the organisms has shown that it belongs mostly to Type IV. The observation is now being extended with a view to producing a correct type of anti-serum for general use in India.

Radiology and Electric-therapeutic Department (Lt.-Col. J. A. Shorten) records several interesting clinical observations. The Superintendent of the Pasteur Institute (Dr. M. J. Nicholas) reports a number of cases of treatment for dog bite though for some unknown reason, many of the patients did not attend the full course of treatment. The general results show, all the same, a high percentage of success as a result of the anti-rabies treatment, the failures being, on an average, only 0.38 per cent of the total number of cases treated. The appendices include a report of the Secretary to the Endowment Fund of the Calcutta School of Tropical Medicine and lists of articles and books published or read by members of the staff during the year under report. Publications relating to the various subjects under review have been issued frequently chiefly through the columns of *Indian Journal of Medical Research* or the *Indian Medical Gazette*.

## The U. P. Academy of Sciences.

THE *Bulletin of the U. P. Academy of Sciences*, Vol. 2, No. 4, May 1933, contains a report of the Proceedings of the Annual Meeting of the Academy held in the Vizianagaram Hall, Muir College Buildings, Allahabad, on Friday, Jan. 13, 1933. The Hon'ble Mr. J. P. Srivastava, M.sc., (Tech.), Education Minister to the Government of the United Provinces, presided.

The Secretary's Report showed that the Academy had 102 Members on its roll of whom 19 were non-resident. Pandit Madan Mohan Malaviya was elected Honorary Fellow of the Academy in recognition of his eminent services in the cause of science and education in the Provinces. Dr. R. Samuel, R. F. Hunter and Dr. P. L. Srivastava were elected Fellows of the Academy. During the year, 43 papers were read before the Academy and its Bulletin received 53 Journals in exchange.

Dr. M. N. Saha, the President of the Academy, delivered his Presidential Address on the "Present Crisis in Dynamics". After reading a message from H. E. Sir Malcolm Hailey, Governor of the U. P., conveying his well wishes to the Academy, Dr. Saha referred briefly to important events of the Academy for the year and then proceeded to the main text of his address.

The Science of Physics is now passing through a great crisis. To be able to appreciate the present crisis, it would be interesting to recapitulate that the sciences created or inherited by the Greek and Hindu savants were all static, *viz.*, Geometry, Algebra, Trigonometry and Arithmetic; they had no science to describe motion. Although they realized and saw around them Nature full of motion, the difficulties in arriving at its correct principles were almost insuperable. It was Galileo who, hemmed in and persecuted by an intolerant clergy, formulated his famous laws of motion. He gave a mathematical expression to 'mass', 'force', 'acceleration' and 'velocity'. But while in the sphere of physics and astronomy, these laws met with almost unlimited success, metaphysicians like Berkley and Hume objected strongly to Galileo's picture and propounded that the human mind must be taken into consideration in any world picture, a fact that Galileo's laws overlooked. To-day Berkley's ideas are found to be more correct than they appeared at his time. For 350 years the science of dynamics held supreme, for it provided an explanation of all known forms of motion and other physical phenomena. But when at the end of the last century it was found that electricity was more fundamental than matter, the first rift in the lute appeared.

It is curious that while classical dynamics led to the foundation of Einstein's 'Theory of Relativity', the theory itself shattered some fundamental concepts of classical physics. Classical dynamics assumed mass as an inherent property of matter, that space can be measured according to the principles of Euclid, and that time is a sort of uniform flux. The historic experiment of Michelson and Morley on ether drift led Einstein to postulate a four-dimensional space where time was continuous with space and points became events. Time ceased to be absolute and distance had no logical meaning. Mass was not an inherent property of matter and the coarser concepts of classic dynamics were replaced by the finer and more accurate principles of relativity; space was not infinite nor possibly time.

In the sphere of intra-atomic physics, Planck's postulation of the quantum theory, which in the beginning was considered by many as an illusion, proved to be the *elan vitale*. But the ignorance of the actual value of the constant angular momentum of the H. proton was a great obstacle in the application of the quantum theory to the solution of atomic physics till Niels Bohr solved the difficulty. This then formed the basis of the explanation of all physical and chemical properties of atoms. According to this theory, the electron can occupy and move only in certain number of orbits; also when the electron occupies one of the higher orbits, after some time it has to jump back into one of the lower orbits although it cannot be precisely stated to which orbit the electron would jump. This can be defined in terms of only probability. This brings us into conflict with the most fundamental concept of classical dynamics, *viz.*, the law of causality. The whole of classical physics is built on the principle that every effect has a cause and, if we deny this principle, we are going back to the days of the ancient philosophers who attributed everything to a Divine Will, and then no need for scientific enquiry exists. Bohr's idea shattered the theory of cause and effect by unwittingly endowing the electron with free will to jump from any one orbit to any other orbit.

The remarkable researches of the physicists replaced the original conception of the electron—the fundamental unit of matter—as something that occupies a Euclidean space point at a definite instant of time, by a minute solar system of a proton surrounded by orbits of revolving electrons. But the matter did not stop there. De Broglie went a step further and replaced the particle of negative electricity by a train of waves. This conception is in direct conflict with classic dynamics where the state of motion of a particle can be defined by its location, position and momenta coordinates. A train of waves cannot be defined in these terms and Heisenberg showed that this indefiniteness was inherent in the nature of things. A little reasoning will show that we observe a particle only by illuminating it with light and if the particle be of the order of the magnitude of an electron, the light itself will impart momentum to it as shown by A. H. Compton. Hence we can never perceive any electron in its natural state and consequently we cannot define its state. Schrodinger replaced De Broglie's wave train by a spherical vibrating elastic membrane and tried to bridge the difference between the classic and modern physics and retain the principle of Causality; but there are many weak points in his theories that cannot be easily explained.

Repeated attempts have been made therefore by physicists to co-ordinate the various conflicting theories which have resulted in the formulation of a variety of symbols like Heisenberg's Matrices, Sixteen-Dimensional Geometry, Spinor-Analysis, etc. In many cases, one is left with the sensation that a mountain has laboured to bring forth a mouse and that too an indefinable one. Thus at present physics is full of speculations which need a mathematical Messiah to clear up. The Messiah is not yet in sight and the physicist, uncontrolled by any sobering influence, finds himself dazed by his own discoveries and inability to interpret his results.

The Hon'ble Mr. J. P. Srivastava congratulated the Academy on its successful working and its usefulness in the development of the Province. He hoped that the Academy would exert its influence in a greater application of science to everyday life which was the immediate need of the country. The average man may not take that interest in science if it were only theoretical as he would if it were more practical. The scientists can really offer a solution to the grave problem of unemployment facing everybody. He wished the Academy a long career of uninterrupted usefulness.

The following were elected office-bearers for the current year:—

*President*:—Prof. K. N. Bahl, D.Phil., D.Sc. *Vice-Presidents*:—Prof. M. N. Saha, D.Sc., F.R.S., F.A.S.B., F.Inst.P., P.R.S.; Prof. B. Sahni, D.Sc., Sc.D., F.L.S., F.A.S.B.; *Hony. Treasurer*:—Prof. D. R. Bhattacharya, M.Sc., Ph.D., D.Sc., F.Z.S.; *General Secretaries*:—Prof. P. S. MacMohan, B.Sc., M.Sc., F.I.C.; Prof. A. C. Banerji, M.A., M.Sc., F.R.A.S., I.E.S.; *Foreign Secretary*:—Prof. N. R. Dhar, D.Sc., F.I.C., I.E.S.; *Other Members of the Council*:—Prof. K. C. Mehta, Ph.D., M.Sc.; Dr. S. S. Nehru, M.A., Ph.D., I.C.S., M.L.C.; Prof. Ch. Wali Mohammad, M.A., Ph.D., I.E.S.; Prof. K. K. Mathur, B.Sc., A.R.S.M.; Dr. P. L. Srivastava, M.A., D.Phil.; Prof. Robert F. Hunter, D.Sc., Ph.D.; Dr. S. M. Sane, B.Sc., Ph.D.; Prof. C. Maya Das, B.Sc., M.A., I.A.S.; Prof. K. C. Pandya, D.Sc.

## The Lady Tata Memorial Trust.

THE Lady Tata Memorial Trust was founded and endowed in April 1932 by the late Sir Dorabji Tata as a memorial to his wife, the late Lady Tata, in order to promote the advancement of medicine by research into the diseases of the blood, with special reference to the leucæmias. Under this trust, Sir Dorabji has set apart a sum of Rs. 25 lakhs, the income from which is divided into various awards.

One-fifth of the net income is ear-marked for the encouragement of research by Indians in India or abroad by the award of one or more prizes annually for the best work done in any scientific investigation which has a bearing directly or indirectly on the alleviation of human suffering. The rest of the income will be devoted towards research in disease of the blood with reference to the leucæmias by the award of prizes, scholarships, fellowships and grants-in aid of such work, and the awards will be open to candidates of any nationality including India. The trustees will be aided by a scientific Advisory Committee having its headquarters in London and including Continental representatives and by an Indian Committee in India.

On the occasion of the second anniversary of the death of Lady Tata, the Trustees announce the following awards:—

Four international scholarships, each of the value of £400 per annum:—

1. Dr. Walter Bungeler, Professor in the University of Frankfort-on-Main and physician at the Seuckenberg Pathological Institute, for research in the experimental creation of leukæmias by chronic Indol intoxication in mice, the influence of deranged products of metabolism in the production of Leukæmia and therapeutic methods of controlling them, under the direction of Professor B. Fisher Wasels, Director of the Pathological Institute of the University of Frankfort-on-Main.

2. Dr. Leonid Dolschansky, Assistant at the Pathological Institute in the University of Berlin, for research in Tissue Culture with reference to the dynamics of blood cell formation, under the direction of Professor R. Rossle, Director of the Pathological Institute in the University of Berlin.

3. Dr. Martin Cyril Gordon Israels, M.Sc., M.B., ch.B., lately House Physician at the Royal Infirmary, Manchester, for research in the application of methods of Tissue Culture to problems of leukæmia and pernicious anæmia, under the direction of Dr. J. F. Wilkinson, M.D., Ph.D., M.R.C.P., Director of the Department of Chemical Investigation and Research at the Royal Infirmary, Manchester.

4. Dr. Charles Oberling, Professor, Faculty of Medicine, Paris, and Director of the Department of Experimental Medicine in the Institute of Cancer, Paris, for research in the transmissible leukæmias of hens, and their relationship to the sarcomas, under the direction of Professor G. Rousey, Professor of Pathology in the Faculty of Medicine, Paris.

Five Indian scholarships, each of the value of Rs. 150 per month:

1. Mr. Nirode Chandra Datta, M.Sc., Assistant at the Indian Institute of Science, Bangalore, for research in the contamination of foodstuffs due to the use of metallic vessels for cooking, storage and other purposes; its effect on growth and metabolism; and the effect of traces of copper and iron on nutrition, under the direction of Prof. V. Subrahmanyan, D.Sc., F.I.C., Head of the Department of Biochemistry at the Indian Institute of Science, Bangalore.

2. Dr. Sudhendra Kumar Ganguli, M.B., for research in Chemo-Therapy of anti-malarial drugs, under the direction of Lt.-Col. R. N. Chopra, I.M.S., Director, School of Tropical Medicine, Calcutta.

3. Mr. Narendranath Ghatak, M.Sc., for the chemical examination of certain indigenous plants of India, under the direction of Prof. N. R. Dhar, D.Sc., F.I.C., I.E.S., Professor of Chemistry in the University of Allahabad,

4. Dr. Mattengunta Venkata Radhakrishna Rao, M.B., B.S., for the chemical, biochemical and pathological investigation of "de-compensated portal cirrhosis" and allied diseases, under the direction of Dr. T. S. Tirumurti, B.A., M.B.C.M., D.T.M. & H. (London), Professor of Pathology at the Medical College, Vizagapatam.

5. Mr. Har Dayal Srivastava, M.Sc., for research in the life-history of Helminth Parasites of man and domestic animals, under the direction of Prof. D. R. Bhattacharya, D.Sc., Ph.D., Professor of Zoology in the University of Allahabad.

Humanity as a whole and India and her citizens in particular are beholden to the Tata Family for more than one benefaction. The Tata Iron Works at Jamshedpur, the Andhra Valley Electricity Scheme, the Empress Mills, the Tata Oil Mills, to mention only a few, stand as monuments to the great Mr. J. N. Tata as the pioneer industrialist of the country who saw that the progress of India lay in her rapid and efficient industrialization. The Tata Education Scheme is a source of immense help every year to bright young Indian students to go abroad and qualify themselves to high distinctions in all branches of learning. Every beneficiary under this scheme will without doubt remain ever grateful to the memory of the great educationist who felt the need for some means of helping deserving Indian students to make their mark in life and provided for it generously. The Indian Institute of Science, with its vast facilities for researches, stands as a striking tribute to the foresight of the great benefactor who so clearly and correctly estimated the value of a thorough scientific education on up-to-date lines in the future progress of India. Twenty-five years of its existence has justified his expectations only too fully, and in the ripe years to come, under the Directorship of Sir C. V. Raman, its future is truly great.

While all these schemes had their foundation in the foresight and wisdom of one of the greatest of India's sons, not a little of their successful fruition is due to the equally generous and enthusiastic support of his two sons, the late Sir Ratan Tata and the late Sir Dorabji Tata whose abiding interest in the progress of India in art, literature, science, and industry is probably unequalled. The latest gift of Sir Dorabji, made a few months before his lamented death, is one more instance of his generosity in the cause of science and the happiness of humanity. We sincerely hope that the several awards will result in great and useful contributions to science and to the alleviation of human suffering.

## Research Notes.

### The Influence of Ovarian and Anterior Pituitary Hormones on Calcium Metabolism.

THEODORE F. DIXON (*Biochem. Journ.*, **27**, No. 2, pp. 410-419) doubts, after experimental verification, the belief that internal secretions have some influence on the calcium metabolism of the body. Careful examination of serum calcium levels of rabbits and dogs after injection of the ovarian and corpus luteum extracts has shown no significant variation. Pregnancy also does not seem to produce any change in the calcium level of rabbits. No noticeable influence of anterior pituitary extract on the serum calcium level of rats is seen, even if the injection is sufficient to produce luteinisation of the ovaries. The older observations of Bell, Widdows and others suggesting changes in serum calcium levels in different stages of the growth of the reproductive organs in man are probably due to other causes. In animals, however, where, as in rabbits, the serum calcium level is variable even under normal conditions of diet, any estimations regarding the serum calcium levels are liable to be faulty.

### Effect of Radium on the Metabolism of Cultures of Embryonic Kidney Tissue.

IT appears that the action of $\gamma$ radiation on protein and carbohydrate metabolism varies. B. E. Holmes (*Biochem. Journ.*, **27**, No. 2, pp. 391-397) finds that a fourteen hours' exposure of embryonic kidney tissue to $\gamma$ rays from 300 mg. radium in a platinum container ·5 mm. thick arrested carbohydrate breakdown while it produced no effect on protein breakdown. The contradictory results obtained by earlier workers like Crabtree and Krontowski were probably due to the faulty containers used which allowed a certain amount of $\beta$ radiation. And the effect of $\beta$ radiation on tissues is fundamentally different.

### Studies on Cholera Bacteriophage.

ASHESHOV and his co-workers have published the first of three parts of their enquiry (*Ind. J. Med. Res.*, **20**, 1101, 1127 1159, 1933). The first part relates to the general technique and gives details of preparation of media, growth of cultures, isolation of the phages and such like operations; the second one is devoted to the classification of the phages on the basis of the Type-test; and the third part relates to the study of the virulence and development of bacteriophage. The defects in the previous methods of evaluating the potency of bacteriophages are indicated and a new one based on the rate of multiplication suggested. The above observations are of considerable importance and should eventually form the basis of an effective scheme of treatment for checking outbreaks of epidemics, but the intrinsic value of the publication has been vitiated by personal opinions which are not entirely supported by the observations. The text is also unnecessarily lengthy, the commonest details in bacteriological technique being described with the most elaborate care. It is hoped that the above defects will be eliminated from later publications.

### The Cultivation of Cereals in Kent in the Thirteenth Century.

MR. R. A. PELHAM, M.A., of Birmingham University, has been unearthing in the Public Record Office some interesting information about the growing of grain crops in Kent during the 13th century. At that period military expeditions were common occurrences, and it was the duty mainly of the sheriffs to raise supplies of food and equipment from both laymen and ecclesiastics, the latter including the Archbishop of Canterbury, the Prior of Christchurch, Canterbury, and the Abbot of St. Augustine's, Canterbury, whose manors were dispersed throughout the county. The study of an account roll, which includes the names and contributors of nearly 700 people in Kent who supplied grain for an expedition to Gascony in 1297, has led to the somewhat startling inference that the distribution of wheat, barley and oats in Kent at that time was almost exactly the same as it is to-day, except in Romney Marsh, which was not then used for rearing sheep. Mr. Pelham, who writes in the *Empire Journal of Experimental Agriculture* (published by the Oxford University Press) concludes from his interesting study that although the tillers of the soil in the days before the Black Death may have used very wasteful methods of cultivation compared with modern practice, they were by no

means ignorant of the main soil conditions that their cereal crops required.

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### Comparative Effect of Tomato and Orange Juices on Urinary Acidity.

IT was reported by Saywell last year that several common fruits exerted a remarkable effect on urinary acidity of men and L. G. Saywell and E. W. Lane (*Journal of Nutrition*, **6**, No. 3, 263, 1933) have continued the work and determined the effect of tomato and orange juices on urinary acidity. An increase in the urinary pH is noticed though the average increase in case of orange juice is a little less than that of tomato juice. There is, however, a decrease in the ammonia excreted. An increase in the alkaline reserve and the organic acids excreted were the other significant changes in the urine.

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### Agriculture in the Empire.

[Views of Mr. J. H. Thomas and Major Walter Elliot.]

To the first number of the *Empire Journal of Experimental Agriculture*, which has lately been issued by the Oxford University Press, the Secretary of State for the Dominions and the Minister of Agriculture contribute some striking expressions of their views on the fundamental importance of research work in the development of Agriculture in the Empire.

Mr. Thomas states that in agriculture, as in every other human activity, we seem to be passing into a new world. There never was a time when tremendous changes were more certain, when events were harder to forecast or when action was more difficult to plan. The founders of the *Journal*, he continues, have had the wisdom to discern and the enterprise to back the only certainty in sight, and they have recognized the one sure contribution which can be made at this moment to the future of the Empire Agriculture. That contribution is to provide that those who are responsible for guiding agricultural policy shall keep in close touch with one another and shall quickly pool for the common advantage every new fruit of discovery and invention in the field of agriculture. As Lord Balfour so truly remarked: "Let us cultivate easy intercourse and full co-operation will follow."

Major Walter Elliot welcomes the new *Journal* as a natural and valuable development from the Imperial Agricultural Conference of 1927, which did so much to foster among scientific workers in all Empire Countries the desire to combine their knowledge and to approach their tasks with the consciousness that the problems of agricultural science concern not only the parish or county or even the country but the whole world. Science knows no geographical boundaries and in an Empire which fundamentally is founded on agriculture, it is impossible to over-estimate the value of co-operative research work in agriculture.

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### Insect Transmission of Peach Yellow.

THE gray leaf hopper, *Cicadula sexanatota* Fall, which is known to transmit aster yellows to a large number of different plants including one species belonging in the Rosaceæ, is unable to transmit aster yellows to peach. L. O. Kunkel of the Boyce Thompson Institute now reports successful transmission of peach yellows by the leaf hopper *Macropsis trumaculata* (*Contributions to the Boyce Thompson Institute*, **5**, 19, 1933). This was found in large numbers on peach trees. It occurs also on plums. It never hops but runs rapidly and hides very well. It scarcely flies except when closely pressed. The adults and nymphs generally feed on twigs and large branches, and are only occasionally found on the leaves. Because the insect produces only one generation in the year, experiments are difficult. The insects were fed on diseased peach seedlings confined in insect-proof cages for varying times. They were then transferred to healthy seedlings. The trees were all kept in green house which was frequently fumigated to keep free from sucking insects. But one drawback is that seedlings on which insects have been fed suffer from wilting which depends on the number and time allowed. The cause of wilting could not be traced to any bacteria or fungi. Probably the insects inject some deleterious substances that cause wilting. The percentage of successful transmission of disease was only 10. Several other species of insects including aphids and borers were tried for their ability to transmit the diseases without any success.

## Science News.

*The Chromosome Number of Crotalaria juncea Linn.:* Mr. R. M. Datta, Department of Botany, Presidency College, Calcutta, reports as a result of his investigations that the metaphase plate in the pollen mother cells shows the haploid number to be 10. It may be remembered that Messrs. S. Ramanujam, N. Parthasarathy and K. Ramiah of Coimbatore Agricultural Research Institute, who have worked on four species of *Crotalaria* of which *C. juncea* is one, have reported at the Patna Session of the Indian Science Congress that the haploid number is 8.

* * *

In reply to Dr. S. L. Ghose's note on *Mosquito and Charophyta*, (*Cur. Sc.*, **1**, 328, 1933) Mr. S. C. Dixit, Wilson College, Bombay, in a short note addressed to us gives the following list of species of Charophyta having no larvicidal properties which are met with in Santa Cruz. (1) *Nitella hyalina*, (2) *Charasuccincta*, (3) *C. flaccida*, (4) *C. zeylanica*. Mr. Dixit observes that opinions freely expressed in journals on scientific matters could not kill further research on this subject.

* * *

The Imperial Institute, South Kensington, announces a forthcoming publication on "Lead: Its Occurrence, Uses, Mining and Metallurgy".

* * *

*Marriage Ceremony among the Vaishnava Castes in Bengal:* Mr. Keshava Sharan Agarwala of Poona, in an interesting short note on the marriage customs of this important community, condemns the lavish expenditure on social functions attending marriages and has pointed out that according to the *Sastras* the religious and the more important part of the function is comparatively simple and inexpensive. A mere exchange of "Kanthi" or a garland of beads between the bridegroom and the bride is according to him sufficient to constitute a valid marriage. But societies and even governments are under the tyranny of customs and traditions and the force of Hindu Law is more honoured in the breach than in the observance, even in semi-religious functions. Mr. Agarwala sees little or no significance in the social practices.

* * *

We have pleasure in congratulating Dr. Karam Narayan Bahl, Professor of Zoology, University of Lucknow, on his election to the Presidentship of the U.P. Academy of Sciences. We wish him and the Academy an uninterrupted career of increasing usefulness.

* * *

At the ordinary monthly meeting of the Asiatic Society of Bengal, held on Monday, the 3rd July 1933, Mr. K. P. Biswas read a paper on 'Living Conifers of the Indian Empire'.

Conifers form an important source of revenue of this country. They are also extensively cultivated in gardens throughout India, Burma and Ceylon for ornamental purposes. The present paper contains a list of 106 species of Conifers at present living within the Indian Empire (with inclusion of Ceylon) to be regarded as a working list to which perhaps additions may be made in the future, arranged alphabetically under a systematic system of nomenclature according to the rules laid down by the Vienna Congress of Botanists in 1905, and subsequently endorsed by the Horticultural and Botanical Congresses in 1930. The locality of occurrence in India and Ceylon is noted under each name. An attempt is made to define whether species are wild or cultivated, and in the latter case when and where introduced. Twenty-three Indian wild species are recorded, representing 21 per cent of the total number. Percentages amongst introduced species are: Chinese and Japanese 21; American 15; European 11; African 4; Pacific and Atlantic 8; Australian and New Zealand 6.

Dr. Baini Prashad exhibited certain Molluscs damaging the brickwork in the King George's Dock, Calcutta.

* * *

The Third International Congress of Experimental Cytology will be held at Cambridge in August from the 21st to the 26th. Prof. Th. Huzella, Professor of Anatomy in the University of Debrecen, is the President of the Congress and his presidential address will be on "Culture des tissues en ses relations aux problemes generales de la biologie et aux problemes speciales de la medicine". The chief features of the Congress will be discussions on the following topics:—"Cell Respiration and Cell Metabolism", "Cell Form and Function as demonstrated by Recent Advances in Tissue Culture", "The Electrophysiology of the Cell," "Entwicklungsmechanik and Explanation", "The Cultivation of Animal and Plant Viruses". Further information concerning the Congress can be had from Dr. Honor B. Fell, Strangeways Research Laboratory, Via Cherybinton, Cambridge.

* * *

Messrs. Adam Hilger Ltd., have put on the market a new X-Ray Fibre Spectrograph which has been designed by W. T. Astbury, B.A., of the Textile Research Department of the University of Leeds for the investigation of all types of fibres, *e.g.*, wool, silk, cotton, hair, etc., and is now used in his X-Ray researches. The apparatus renders possible the study of the behaviour of these substances under a variety of conditions, such as tension and humidity and thus yields important information on the effects of wear, or of processes of manufacture, upon textile materials. With its accessories it provides a complete equipment for X-Ray fibre research and should prove indispensable in every textile research laboratory.

* * *

Sir George Anderson, till recently Director of Public Instruction to the Government of the Punjab, has been appointed Educational Commissioner to the Government of India in succession to Mr. Clarke. The Government of India is seriously considering the revival of the All-India Board of Education which was abolished nearly a decade ago and it is understood that Sir George Anderson will be entrusted with the task of its reorganization.

* * *

We have received a copy of *Electrotechnics*, No. 6, April 1933, published by the Electrical Engineering Society, Indian Institute of Science, Bangalore. Besides notes about the new equipment and research work of the Department of Electrical Technology of the Institute, the journal contains articles on "Preparation for Leadership"

by Dr. M. O. Forster; "Mercury Arc Rectifiers with Control Grids" by Prof. J. K. Catterson-Smith; "The Measurement of the Frequency of Electrical Oscillators" by S. K. Kulkarni Jatkar and Dr. H. E. Watson; "Echo Suppression in Wire and Radio Telephony" by S. P. Chakravarti; a description of the total solar eclipse in Canada; a note on frequency standards and measurements; a resume of polyphase compensated commutator induction motors by Dr. J. J. Rudra and abstracts of lectures and papers read before the Society during the year 1932. The personal notes about members of the Society, reviews of books and other news of the activities of the Society make the publication, which is priced at Rs. 2 only, interesting reading.

* * *

As we go to Press, we have received a copy of Sir M. Visvesvaraya's illuminating address, "Industrializing India," delivered before the Mysore Chamber of Commerce on the 10th July. The opinions of such an eminent statesman as Sir M. Visvesvaraya, coming as they do, on the eve of the Simla Conference convened by the Government of India, are entitled to great consideration and we hope to review them in these columns shortly.

We acknowledge with thanks the receipt of the following:—

"Canadian Journal of Research", Vol. 8, No. 4.

"The Review of Scientific Instruments," Vol. 4, Nos. 1 to 5.

"Journal de Chimie Physique," 25th April 1933.

"The Journal of Chemical Physics," Vol. 1, No. 5.

"Nature," Vol. 131, Nos. 3315 to 3318.

"The Chemical Age," Vol. 28, Nos. 724 to 727.

"Medico-Surgical Suggestions," Vol. II, Nos. 5 and 6.

"Bulletin of the U. P. Academy of Sciences," Vol. 2, No. 4.

"The Biochemical Journal," Vol. 27, No. 2.

"The Indian Forester," Vol. 59, No. 6.

"Scientific Indian," Vol. 9, No. 53.

"International Geological Congress—Sixteenth Session," U.S.A. 1932. (Pamphlet.)

"Electrotechnics," No. 6, April 1933.

"Journal of Agricultural Research," Vol. 46, Nos. 6 and 7.

"The Journal of Nutrition," Vol. 6, No. 3.

"Half-Yearly Journal of the Mysore University," Vol. 6, No. 1.

## Reviews.

HISTORY AS A SCIENCE. By Hugh Taylor 1933 (London: Methuen & Co., Ltd., W.C. p. vii+138, price 7/6 net.)

The book is undoubtedly a scholarly production. The author has treated the subject with insight and originality, creating a new atmosphere for history.

If the function of science is to investigate the facts and phenomena in the realm of reality, it is clear that the claims of history to be ranked as science are admissible. To forbid them is to set up a wholly arbitrary restriction of science. If the social phenomena present features which do not lend themselves to theoretical treatment by methods devised by other branches of natural science, the proper procedure for history would be to devise its own technique for dealing with them. Everyone is at liberty to define Science as he pleases, but no definition can be permitted to fly in the face of the actual state of affairs. This would happen if we restrict the definition to mathematical physics. We would be making a fatal error and injure an epoch of scientific thinking if we consider that no branch of knowledge which does not lend itself to physico-chemical technique is entitled to be called science. On the other hand, science is an attempt to bring facts into logical order. History inherently is incapable of introducing measurements in its technique and may be incapable of expressing its general conclusions in precise mathematical formulæ. But this defect alone will not invalidate history to be treated as a branch of inexact sciences.

In the opening chapter, the author points out that the difficulties which beset the study of history arise from the fact that it is simultaneously concerned with the interests of both conduct (morality based on religion) and knowledge. Taylor thinks that in a conflict of science and religion, the cause of the latter must have a wider following, because a stable society based on orderly life is a condition precedent to the progress of science. In the first place, science is not opposed to religion in the higher sense of the term and both represent two avenues of approach to truth. But science has no patience with dogmas, creeds, ritualism, superstitious beliefs and sectarianism which are beyond verifiable facts. True religion is based on dependence of life, which is the ultimate and fundamental fact of existence; and human heart, whatever the head may dictate, instinctively yearns for succour in moments of despondency and helplessness and the existence of a Supreme Being, science can neither corroborate nor disprove. The modern tendency of science is to become metaphysical and sooner or later must accept the first postulate of a Great

Cause whose laws it is attempting to unravel. We do not agree that the cause of science is opposed to that of morality or right conduct or true religion and it is unnecessary to make extravagant claims on behalf of the latter to establish its superiority. Any attempt to do so is apt to land one in an untenable position. For instance, when the author says that men must live (society based on conduct) before they can know, the dictum is true of a social order under the control of a governing authority, but not of primitive society. Primitive man sustained himself not through the mystical charms of the Ten Commandments but by his skill in hunting, and dissimulating by lying concealed near the water holes and imitating the calls of animals and in circumventing the pursuits of his antagonists. The exploded controversy of the nineteenth century which raged over the conflict of science and religion has no basis in fact if we define and delimit the connotation of the latter term and is unnecessary to be evoked as offering difficulties to the interpretation of the social progress and political achievements.

The object of history is defined as the discovery of the principles of human evolution and the whole book is devoted to defend this thesis. There is one point in the discussion on which we are inclined to be sceptical. The truth which the historian sets out to discover is not of the same order as the one which falls within the province of the scientific investigators. If the apparatus is arranged without initial error or defects in the parts, then the observed facts cannot be far from truth, unless the observer is careless or clumsy in his interpretation. The material on which the historian works is human document which at the time of preparation cannot but be coloured by the passions and prejudices of the times. The very source is vitiated. If in 2014 A.D. the future historian were to proceed to investigate the truth about the Great War, he has to rely on the evidence of despatches, bulletins and other documents which the belligerents and the allies have published from time to time and each presents his case from his standpoint, in defence of his actions. These evidences on which the historian has to work will not have the same value as the facts presented by an experiment.

For purposes of a scientific history which deals with the evolution of social and political institutions, mankind will have to be treated as a single unit and obviously this is impossible, for the ethnological, cultural and social differences among the races are too wide and deep to be brought under one general theory. But nevertheless the great events of nations and the factors of their evolution must have a common substratum capable of a scientific treatment. Scientific history is possible and even metaphysical history. But we prefer, we confess, Macaulay, Green and Froude to Seely, Mahan and Lord Acton. The narrative history has always an irresistible interest to man who is deeply concerned with the personal triumphs of his ancestors, their tastes, manners, dress, social weaknesses and strength, public amusements, their pains and their graces, their joys and tragedies, their forms of government and their public finance and foreign relations.

We have read this book with great profit. It opens out new fields of investigation and invests history with a new and attractive garb. Frankly, historical works written on the lines suggested by the author, must be invaluable contributions to historical literature.

* * *

RESPIRATION IN PLANTS. By W. Stiles and W. Leach. (Methuen & Co., Ltd., London, 1932. Price 3*s.* 6*d.*)

In this small monograph of 124 pages on respiration in plants, the authors have been able to compress a good deal of information which, as they themselves say, is readable and understandable by the elementary student in Botany, and is also of value to the advanced student. In the four chapters into which the book has been divided, the authors have endeavoured to marshall facts, quoting recent researches of a fundamental nature only, with a view to lead the student of the subject into estimating a correct picture, as far as possible, of the cell dynamics concerned with this fundamental property of the living matter, *viz.*, Respiration. Chapter I deals with the physiological importance of the process in the living mechanism of the plant, *viz.*, the release of energy by a process of dissimilation of substances of a higher energy content. Chapter II deals with respiration of normal plants under aerobic conditions where the variability of the respiratory intensity under various conditions of development, season, and other interval changes in the plants and plant organs, and also under

the influence of external factors, is discussed. Chapter III deals with anaerobic respiration where, without making an attempt to connect it with the aerobic respiration, the authors have presented significant facts to prove the general existence of respiration without oxygen, the production of alcohol, the similarity of effects of external agencies on the intensities of aerobic and anaerobic respirations and the variability of the ratio of the anaerobic to the aerobic respirations in different plant organs. Of particular interest is their discussion of the behaviour of ripening apples on transference to nitrogen from air investigated by Blackman and Parija, where a rise of respiration takes place under anaerobic conditions, a behaviour which, though exceptional, may, in the authors' opinion, be a common feature characterstic of senescent fruits. Chapter IV which deals with the Mechanism of Respiration in plants, is a digested summary of investigations on plant respiration. After discussing the general nature of fermentation in the yeast cells, the authors have given a concise account of oxidising systems in plant and animal cells, including the non-enzymatic oxidising systems, such as, the Glutathione of Prof. Hopkins. They next pass on to a sufficiently exhaustive discussion of the stages in the respiration process, where the latest views are quoted and summarised, holding respiration as a balanced reaction commencing from the reserve respirable material and ending in its complete oxidation to substances of least energy content, such as, $CO_2$ and $H_2O$. During this process many intermediate reactions occur, such as the hydrolysis of the reserve material, its activation prior to oxidation, the glycolysis of the activated material and finally the respiration of these substances under either aerobic or anaerobic conditions. The quantitative output of the end-result would depend upon the working of this series of balances in the reactions involved. The latest scheme which presents these balanced reactions in something like a conceivable picture of the actual events which may be taking place in the plant cell is that of Blackman based on Parija's observations. Of the greatest interest to the biologists is Blackman's conclusion that oxygen plays a double part in plants, *viz.*, direct oxidation in the final process of respiration and an earlier influence altering the rates of production of the substrates which are utilised in the final stage of respiration. This substantiates in an experimental way the general idea that oxygen (the " vital air " of the biologists) has manifold effects in various directions in the life-reactions of the living cell.

Though the authors cannot claim to have a thorough knowledge of the chemical aspects of the problem, they have been able to present a clear and concise discussion of all the chemical reactions which are known to be concerned in the process of respiration. The book, being a good summary of the more important recent work on this physiological process, should prove very useful to the teacher, the student and also the investigator. This is perhaps the first monograph in English by English authors of the recent work on respiration which, though concise, is sufficiently comprehensive.

R. S. I.

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FIRST PRINCIPLES OF TELEVISION. By A. Dinsdale, pp. xv + 234. (London. Chapman & Hall, Ltd., 1933. Price 12*s.* 6*d.*)

Progress in Television has been so rapid in the past few years that it is difficult for an author to bring the various practical methods and systems that are in vogue, and arrange them in the proper sequence so as to be easily understood by the general public. The author of this book has very wisely sifted the whole field and presented in an interesting manner what is necessary, to serve as a good background to a proper understanding of the subject.

A few pages have been deservedly devoted to the elucidation of some elementary principles in optics without which it is difficult for the layman to comprehend the various operations involved. The chapters discussing the various systems are well laid. It is particularly interesting to note that the author has taken considerable pains to review the present state of Television in various countries without forgetting even the most recent private demonstration which he saw in America.

The book is eminently suited for all those who want to have a general idea of the principles involved in Television, though the author would have catered for a wider circle had he included a few chapters for the serious experimenter. However the non-technicality of the language and the interesting way in which it is written render the book well worth the attention of all those interested in the progress of Television.

C. CHANDRASEKHARIAH.

GENERAL MECHANICS. By Prof. Max Planck. Translated by H. L. Brose. (London: Macmillan & Co., Ltd., 1933. Price 12*s*.)

Prof. Max Planck's book on "General Mechanics" is an elementary book on the subject which is divided into two parts, *viz*., "Mechanics of a Material Point" and "Mechanics of a System of Material Points" including mechanics of a rigid body. Part I is divided into six chapters which deal with motion in a straight line and in space, central force, potential, integration of the equations of motions, relative motion, and constraints. Part II is divided into four chapters which deal with Statics and Dynamics of a rigid body; and Statics and Dynamics of an arbitrary system of points.

The beginner, who tries to learn mechanics, feels the difficulty in understanding the physical ideas underlying the different systems in mechanics. It has been the aim of the author to explain in an elementary way the physical motions involved in mechanics. He has also endeavoured to present the structure of mechanics as something evolved step by step. He has therefore departed from the traditionally prescribed method of presenting the subject as a finished product. The traditional method may be effective from the practical point of view, but is open to criticism not only on logical grounds, but also to the fact that it is likely to confuse the beginner who wants to grasp the physical principles underlying the Science of Mechanics. In several cases, the author sacrificed conciseness and elegance, and the proofs he has given are not necessarily short and elegant ones, but they are generally very lucid and suggestive. Instead of placing "ultimate definitions" at the beginning of ready products, the author, by discussing definite problems, has tried to show how these definitions became necessary and useful.

It is doubtful whether many scientists will agree with the author that "the enunciation of Newton's Law of Gravitation is not *au fond* an expedient invention, but rather it is to be regarded as an epistomological discovery". In this book "Vis Viva" and "Kinetic Energy" have been used synonymously whereas English Mathematicians usually define "Vis Viva" as twice "Kinetic Energy". By introducing an interesting little dialogue the author has explained quite effectively that a couple can be transported to any position in its own plane without altering its physical meaning. Every student of Physics and Mathematics should read this book.

A. C. B.

* * *

A TEXT-BOOK OF CHEMISTRY. By H. A. Wootton and C. W. R. Hooker. (Pp. 488. Cambridge: The University Press. Price 6*s*.)

The portion of the book dealing with theory is well written and most of the chemical terms are explained in detail as they occur. The descriptive portion of the book is ill-balanced; while the non-metallic elements and their compounds have been dealt with in some detail the treatment of the metals is meagre. The metallurgy of even technically important metals like aluminium, lead and copper is disposed of in a few sentences. The periodic classification is not dealt with at all. Further a few advanced ideas are introduced at too early a stage for the young beginner in Chemistry to appreciate or understand. The second part of the book contains instructions for practical work in fairly good detail; there are chapters dealing with practical work like preparation of substances, volumetric anlysis, etc. The authors of the book have attempted to bring forth a volume which is ambitious in its scope. Naturally it has not been possible to do adequate justice to all branches of Chemistry.

The book can only be recommended to Libraries as a volume for general reference but it is not suitable as a text-book.

M. SESHAIYENGAR.

* * *

FOUNDATIONS AND METHODS OF CHEMICAL ANALYSIS BY THE EMISSION SPECTRUM. Being the authorised translation of "Die Chemische Emissions spektralanalyse". By Dr. Walther Gerlach and Dr. Eugen Schweitzer. (Adam Hilger Limited, London, 1933.)

Although it is only three years since "Die Chemische Emissions spektralanalyse" was published it has proved so valuable to workers in the field that an English translation of it should be welcome to many.

The English edition has departed from the original only in two small sections. Table VIII on page 80 provides additional data for the quantitative estimation of iridium in platinum. The section on spectrophotometry is somewhat amplified by a description of Twyman and Simeon's arrangement and a short description of

Schwarzschild's law of equality of blackening of the photographic plate.

The get-up of the book is excellent.

K. R. K.

* * *

FLIGHT OF FISHES. The mechanism, duration and extent of the flight of fishes are subjects of perennial interest to scientists and laymen alike. It is a matter of great pleasure, therefore, that Dr. Carl L. Hubbs in a recent contribution (*Papers Michigan Acad. Sci. Arts and Letters*. **17**, 575, 1933) has recorded detailed and comprehensive field observations on the flight of fishes. The extensive data thus collected have enabled him to make a statistical study of the flight of the Cypselurinæ, the true flying fishes, and to make remarks on the evolution of the flight of fishes. There is ample justification for Dr. Hubbs' remarks that "too much of what has been written" about the flight of fishes "has been unduly deductive. Many have argued from pre-conceived ideas of the flight of birds, or from generally erroneous conceptions of the mechanics of flight, just how fishes must fly." Dr. Hubbs carried out his observations in 1929 "in the East and South China seas, about western Java, and around the entire main island of Japan," but most of his studies were done during the first half of June in the course of a journey "from Java through Java Sea, Straits of Macassar, Celebes Sea, among the Philippine Islands, and on to southern Japan." The small size of the steamer, in which Dr. Hubbs made his trip, and its slow speed were most favourable for carrying out this type of work.

As a result of these field studies we now know the flight of the most primitive flying fish, *Oxyporhamphus*. It consists of a low, single leap of about 5 to 8 metres. *Exocœtus*, in which only the pectorals are enlarged and hence called Monoplane Flying Fishes. also makes simple leaps of about 10 to 20 metres. In the Cypselurinæ, in which both the paired fins are enlarged — Biplane Flying Fishes, flight of fishes reaches its ultimate perfection. In this group flight is initiated by the surface skimming or taxi movements, and the sole propulsive power is provided by the side-to-side sweeping of the caudal fin. Once the fish is actually in the air, there is no further acquisition of power, except such as may be derived from favourable utilization of air currents. The longest single flights were of 12 and 13 seconds; the longest compound flight, when there are successive leaps, was almost 30 seconds. The average speed attained in the air is about 10 metres per second.

The mode of surface skimming, the position and function of the fins in flight, the control of flight direction, the duration of the flights, the number of successive leaps and the methods of return to the water are all elaborately described. The function of the wings of young flying fishes is also indicated.

Reference is also made to the flight of certain fresh-water fishes and it is concluded that "many fishes make leaps of varying length and perfection. Certain of the Percesoces are adept at leaping. Some of the relatives of the flying fishes leap; others only skim the surface. These two types of aerial locomotion were probably independently evolved. Since some flying fishes merely leap, whereas others initiate their flight with surface-skimming or taxi, doubt is thrown on the monophyletic origin of flight in the true flying fishes."

S. L. H.



1222-33 Printed at The Bangalore Press, Bangalore City, by T. Subramania Aiyar, Superintendent, and Published by K. S. Varadachar, M.A., M.Sc., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.